

CHEMICAL & METALLURGICAL ENGINEERING

For the Production Man in the Chemical Engineering or Process Industries interested in heavy, fine, and electro-chemicals, cement, lime, ceramics, glucose, coal products, explosives, fertilizers, glass, leather, paint, varnish, oils, pulp, paper, petroleum, rubber, soap, sugar and similar products.

a ton of pressure at your finger tips

Hydraulic lubricant pressure is available in every Nordstrom Valve at a turn of the lubricant screw, permanently sealing the valve against leaks and releasing the tapered plug if it ever becomes tight. This simple hydraulic lubricant principle has revolutionized the valve industry.

Nordstrom Valves are successfully used in the Chemical Industry in a variety of services. Among these are: pump manifolds, filling lines, discharge from agitators, pressure vessels, nitric acid, sulphuric acid, dry



chlorine, hypochlorite bleach liquors, hot concentrated caustic solutions, acetic acid, etc., etc.

Ask for your copy of Catalog No. 6.

Special Lubricants

"Merco" Lubricants are suited to a wide range of valve services. We recommend them for use in all Nordstrom Valves.

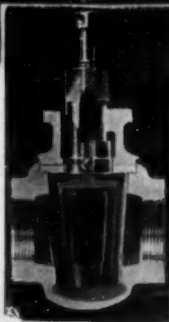
Merco Nordstrom Valve Company
Subsidiary of The Merrill Company
Engineers . . . Manufacturers

Boston—184 Boylston St.	New Orleans—Masonic Temple Bldg.
Buffalo—Genesee Bldg.	New York—11 W. 42nd St.
Chicago—176 W. Adams St.	Pittsburgh—Clark Bldg.
Dallas—Magnolia Bldg.	San Francisco—343 Sansome Street
Detroit—2842 W. Grand Blvd.	Seattle—Colman Bldg.
Houston—Petroleum Bldg.	
Los Angeles—556 S. San Pedro Street	

Agencies in Principal Cities

Factories: Oakland, California and Belleville, New Jersey.
Canadian Manufacturers—Peacock Bros., Ltd., Montreal.
Cobalt, Winnipeg, Vancouver.
England—Audley Engineering Co., Ltd., Newport, Shropshire.

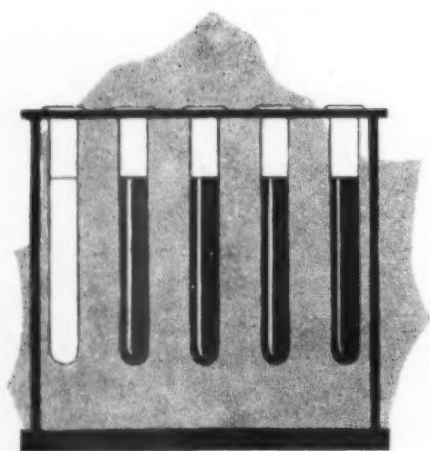
Nordstrom



Valves

And now we present
a tremendous saver
of Time and Money
the...

TOLHURST REG. U.S. PAT. OFF. **THICKENER**



The Tolhurst Centrifugal Thickener handles even light, flocculent precipitates—producing the density desired in but a fraction of the time ordinarily consumed.

A new development—a revolutionary advance—a machine that solves thickening problems for the process industries and contributes time, labor and equipment-saving advantages of the utmost importance.

The Tolhurst Centrifugal Thickener, in addition to its purely economic advantages, produces the finished product uniformly and at an accurate predetermined degree of wetness.

With those manufacturers who are experiencing losses through excessive waste, whose thickening processes consume too much in time, labor or equipment, the Tolhurst Machine Works requests the opportunity of discussing this machine.

TOLHURST MACHINE WORKS, INC.
Troy, N. Y.

New York Office: 30 Church St.

Chicago Office: 8 So. Dearborn St.

San Francisco Representative:

B. M. Pilhashy
Merchants Exchange Bldg.
San Francisco, Calif.

Canadian Representative:

W. J. Westaway Co.
Westaway Bldg., Hamilton, Ont.
455 Craig West, Montreal, P. Q.



VOLUME THIRTY-SIX

Nitrogen Fixation Plant of Lazote, Inc., at Belle, W. Va.

NUMBER SIX

JUNE, 1929

Hydrogenation of Petroleum Promises Revolutionary Development for American Industry	332
BY S. D. KIRKPATRICK	
Cleveland Clinic Disaster Has Lesson for Chemical Industry	334
EDITORIAL STAFF	
Calculating Specific Heats of Hydrocarbon Vapors	336
BY W. K. LEWIS AND W. H. McADAMS	
Recent Industrial Developments Discussed by Electrochemists	337
EDITORIAL STAFF REPORT	
Modern Practice Crystallized in New Tunnel Kiln	340
BY G. S. HOUSMAN AND G. E. SEIL	
High Purity Magnesium Produced by Sublimation	345
BY H. E. BAKKEN	
Eliminating Health Hazards in Chromium Plating	351
BY J. J. BLOOMFIELD AND WILLIAM BLUM	
Editorials	329
Readers' Views and Comments	364
Chemical Engineers' Bookshelf	365
Selections from Recent Literature	367
Government Publications	368

S. D. KIRKPATRICK, *Editor*

HENRY M. BATTERS
Market Editor
JAMES A. LEE
THEODORE R. OLIVE
R. S. MCBRIDE
Washington
PAUL D. V. MANNING
San Francisco
Assistant Editors

M. A. WILLIAMSON
Publishing Director

McGRAW-HILL
PUBLISHING COMPANY, INC.,
Tenth Avenue at 36th Street
NEW YORK, N. Y.
Cable Address "Machinist, N. Y."

JAMES H. MCGRAW, Chairman of the Board
MALCOLM MUIR, President
JAMES H. MCGRAW, JR., V.-Pres. and Treas.
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
HAROLD W. MCGRAW, Vice-President
C. H. THOMPSON, Secretary

NEW YORK Dist. Office, 285 Madison Ave.
WASHINGTON, National Press Bldg.
CHICAGO, 529 N. Michigan Ave.
PHILADELPHIA, 1600 Arch St.
CLEVELAND, Guardian Building
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Boulevard St., London, E.C.4

Publishers of
Aviation
Food Industries
Electrical World
American Machinist
Electrical Merchandising
Engineering and Mining Journal
Chemical and Metallurgical Engineering
Bus Transportation
Power
Coal Age
Radio Retailing
Electric Railway Journal
Engineering News-Record
Ingenieria Internacional
Construction Methods
Electrical West
(Published in San Francisco)
American Machinist—European Edition
(Published in London)

SUBSCRIPTION PRICES: United States and its Possessions, Canada, Mexico and other countries taking domestic postage rates, \$3 a year. All other foreign countries, \$5 a year. Single Copy, 35 cents. Published monthly. Entered as second class matter, July 13, 1918, at the Post Office, New York, N. Y., under the act of March 3, 1879. Printed in U. S. A.

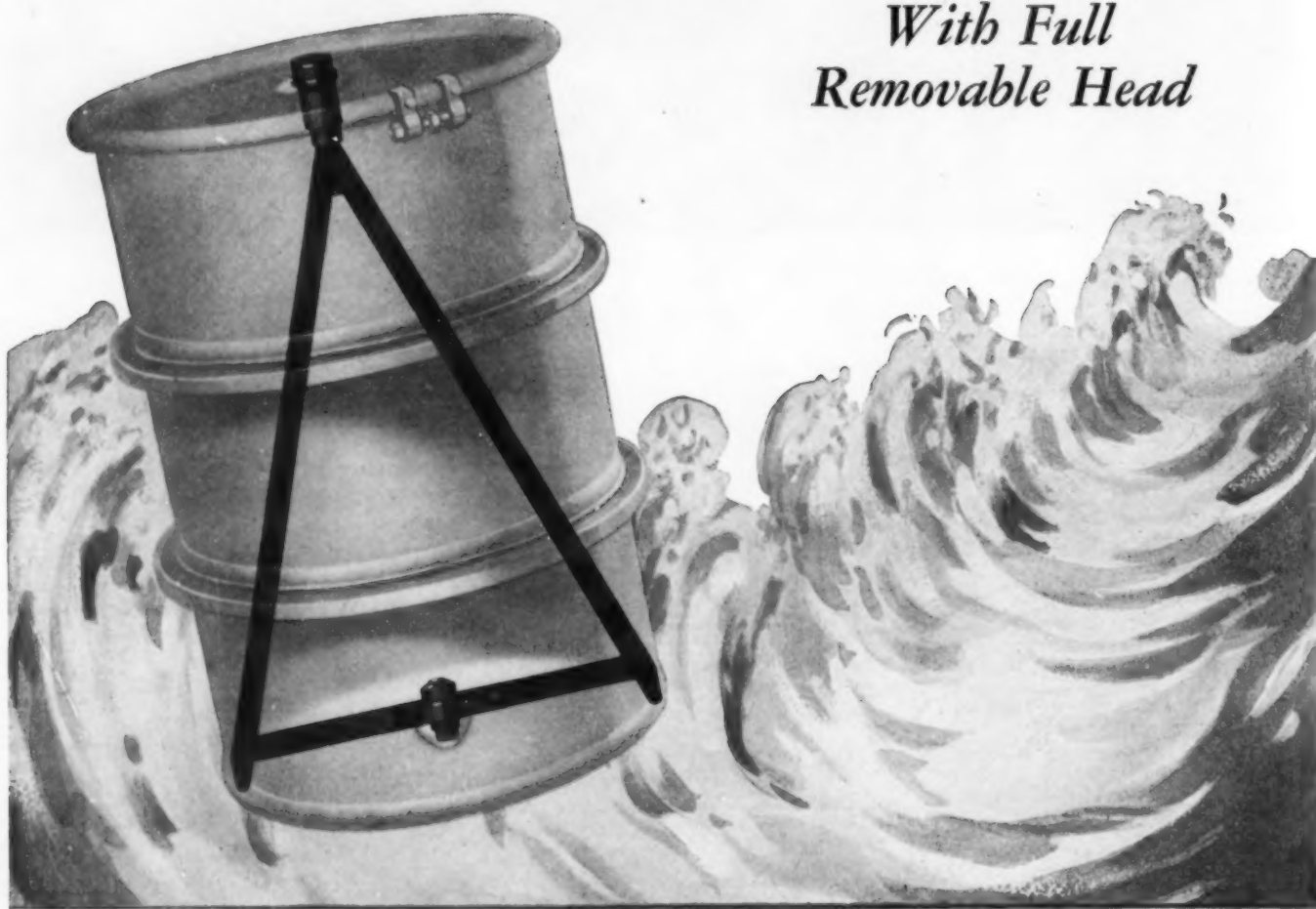
Copyright, 1929, by McGraw-Hill Publishing Company, Inc.
CHANGE OF ADDRESS
Subscribers are requested to send both the old address and the new address when they move to a new address.
Member—Audit Bureau of Circulations.
Member—Associated Business Papers.

Number of Copies Printed This Issue, 13,200

How Chemical Engineering Has Improved Aircraft	348
BY GEORGE E. WALKER	
Defeating HCl Corrosion in Chemical Processing	355
BY SIDNEY SCHEIN	
Chemical Plants Are Turning to Welded Construction	352
BY ALAN G. WIKOFF	
New Developments in Gas Making Revealed at A.G.A. Convention	359
BY R. S. MCBRIDE	
Automatic Control Developed to Maintain Uniform Suspension Density	362
New Southwest Bids for Chemical Development	358
The Plant Notebook	
Electrical Equipment in Chemical Plant	369
BY W. E. WARNER	
Eliminating Shortage of Compressed Air	369
BY F. M. AHR	
Equipment News	370
Manufacturers' Publications	374
Patents Issued, May 7 to May 28	375
News of the Industry	376
Annual Convention of N.F.A.	377
Personal Notes	382
Obituary and Industrial Notes	383
Production and Consumption of Chemicals	384
Market Conditions and Price Trends	386
Industrial Developments	391

AGITATOR DRUM

*With Full
Removable Head*



For Shipping Lacquers — Varnishes — Paints

The new Hackney Removable Head Steel Agitator Drum gives manufacturers a better, cheaper way to ship lacquers, varnishes, paints and other viscous materials that have a tendency to settle.

With the sturdy, welded agitator—permanent or removable type—the contents of the drum can be completely stirred, right to the bottom of the chime—without removing the head.

And when the head is removed, the drum becomes an exceedingly efficient mixing tank.

Cleaning is greatly simplified—for the smooth straight sides and brazed arched chimes of Hackney Steel Drums are free from all cracks and crevices. And the full removable head leaves no lugs or inward projections to catch and hold the material.

A post card will bring you complete details—and an exceedingly interesting story of low shipping costs and improved service—that can point the way to bigger profits for you. Send the card today.

PRESSED STEEL TANK COMPANY

1149 Continental Bank Bldg. - - - - Chicago
1325 Vanderbilt Concourse Bldg. - New York City
5709 Greenfield Avenue - - - Milwaukee, Wis.

Hackney
MILWAUKEE

CHEMICAL & METALLURGICAL ENGINEERING

M. A. WILLIAMSON, Publishing Director

VOLUME THIRTY-SIX - NUMBER SIX

JUNE, 1929

S. D. KIRKPATRICK, Editor

Better No Tariff Than Political Claptrap

H. R. 2667 is now in the Senate and the political complexion and record of that body make it extremely hazardous to predict the probable outcome of any tariff legislation. There is at least the possibility that a combination of Democrats and insurgent Republicans will succeed in raising still higher the rates on agricultural raw materials and at the same time drastically reducing those on manufactured products. Such action would result immediately in a conference tangle and eventually in a Presidential veto. The second possibility is that through some form of log-rolling, at which the Senate is particularly proficient, the farm and industrial interests will reach a compromise that will force the proposed duties to new high levels and open the way for similar treatment of items untouched by the House bill. Obviously this, too, would invite a veto, for President Hoover has asked many times for only a "limited" revision. He cannot be unmindful of the disasters that followed in the wake of the Payne-Aldrich bill, passed under entirely comparable circumstances.

A new chemical schedule is needed, but from all standpoints it would be better by far that the present law be continued—even with its several inequalities—rather than complete surrender to the pygmy politics that have lately characterized the Senate's actions.

Chemical Changes That Foreshadow Industries

CHARLES F. KETTERING'S remark that "nothing in industry is as constant as change" applies most aptly to the chemical engineering industries at the present time. Never before have important technical developments appeared with such frequency or promised such fundamental industrial changes. To list but a few of these is to indicate the great resourcefulness that organized research has given to the American chemical industry.

At the top of the list from both technical and commercial viewpoints are the newly discovered potentialities in the hydrogenation of petroleum. This process promises to revolutionize an industry that has already profited greatly from chemical engineering advance. If it may be said that the cracking process made two gallons of gasoline flow where only one flowed before, then hydrogenation will make four or even more. The lowest grade of crude oil, even the residue and refinery "slops," can be converted by hydrogenation into 100 per cent (or more!) of motor fuel or other more valuable products. Gasoline thus becomes, for the first time, a synthetic organic chemical with production sub-

ject to the flexible control of chemical engineering operations. More important from the public viewpoint is the element of conservation of a great natural resource, for if hydrogenation is broadly applied millions of barrels of low-grade oil will become a valuable source of motor fuel.

Synthetic ethyl alcohol is beginning to be talked about even in Congressional circles. During the recent tariff debates, when certain misguided friends of the farmer were arguing for a prohibitive duty on blackstrap molasses in the belief that the alcohol industry would turn to corn as a raw material, someone let the cat out of the bag. A letter was read from the Commissioner of Prohibition stating that a license had been issued to an experimental plant in West Virginia for the synthesis of ethyl alcohol from a petroleum byproduct and that the company was planning greatly to enlarge its output. This is perhaps a long way from commercial production but it indicates that, if need be, the industry can render itself independent of imported raw materials. The same organization, which has to its credit a long list of synthetic solvents, has lately become a commercial producer of acetone from isopropyl alcohol.

Synthetic acetic acid made from calcium carbide has been an article of commerce for a number of years, but at least two other promising sources are just around the corner. With a proper catalyst it is a short step from ethyl alcohol to acetic acid, or from ethylene obtained by cracking oil or natural gas. Acetic anhydride is being made abroad directly from glacial acetic acid by the use of a catalyst. Similar developments are under way in this country and only within the past few days a new cellulose acetate process has been announced in Wall Street.

Not long ago an oil refiner developed a distillation process that required the use of diphenyl as an indirect heating medium. This compound at that time was but a laboratory curiosity and sold for \$40 a pound. The oil refiner put the matter of its production up to an enterprising chemical manufacturer in the South. An intensive research program was started and in four months' time the laboratory work was completed, the plant designed and built and one hundred thousand pounds had been delivered to the oil refiner at a price of about forty cents per pound—or just one-one hundredth of the price four months before.

It is this sort of an achievement that confirms our confidence in the resourcefulness of American chemical industry. We are moving forward rapidly. Our departments of "systematic change-making," as Mr. Kettering likes to call the research organizations, are functioning with remarkable success. If their outputs of processes and ideas are economically and technically sound, they portend the development of many new industries.

Developing a Technique of Economic Balance

INDUSTRIAL prosperity is no longer static. It has come to mean a progressive improvement rather than a satisfactory but fixed state of affairs. Scientific research and engineering advance have contributed greatly to this accelerated progress, for we have developed a remarkable technique for applying the material sciences of chemistry and physics to the production problems of industry. Now, as productivity increases, industry is faced with the necessity for extending the research method to the less tangible field of the social sciences. Economics, psychology and sociology hold real potentialities for improving distribution, management and marketing. To apply them intelligently is to control the forces that will make for industrial stability.

Opportunities for economic study in the chemical engineering industries are just beginning to unfold. As processes have been carried into production there have been corresponding developments that have opened up new markets. As competition has dictated lower prices there have been compensating reductions in costs, resulting from more efficient operation or greater volume of output. More often than not this favorable balancing of production and consumption, prices and costs, has been the result of fortunate circumstance rather than the outcome of careful planning. Only a few progressive organizations within the field have developed the type of commercial research that gives a sensitive control of these basic economic forces.

To maintain the organic balance of our entire economic structure is the most serious obligation of industry, in the opinion of the distinguished committee of the President's Conference that has just reported on "Recent Economic Changes in the United States." The committee sees in this obligation a vital problem for an informed business leadership. Ignorance of economic principles on the part of management, selfish greed, wasteful exploitation of natural resources, artificial price advances and reckless speculation are disturbing factors that can easily destroy our present equilibrium. On the other hand, orderly knowledge, accumulated through research and study, and applied with mutual confidence and teamwork, will go a long way toward making possible the complete control of our economic system.

The major problem, then, is to develop a technique of economic balance. It cannot be done by the economist alone, and it will not be effective unless it is put to practical use. All of the human forces of industry, whether in research or engineering, production or distribution, management or administration, must contribute something to this philosophy of economic control. It is our only guaranty for the type of progress we now call "prosperity."

Fifty Years of Enlightenment

IN Light's Golden Jubilee the nation is expressing its sincere gratitude and appreciation, its admiration and esteem for Thomas A. Edison and the eminent technical men who have helped to develop the incandescent electric light. The celebration, in which all the country will participate, began in Atlantic City with the opening of

the annual convention of the National Electric Light Association, and will continue throughout the summer and early fall, culminating on Oct. 21, the fiftieth anniversary of the invention, with the dedication of the Edison School of Technology in Detroit.

The extent of the influence of the modern electric lamp upon industry is difficult to evaluate. In inventing the practical incandescent lamp Edison rendered a service to humanity unrivaled in the history of science and industry. For this reason the fiftieth birthday of the invention of the first practical lamp should be the greatest golden jubilee the nation has ever celebrated. As everyone has been reached and benefited by this invention, it will be the purpose of the sponsoring committee of distinguished men and women to make this anniversary a good-will expression of all people and all industries.

Chemical engineering industries have a twofold interest in the electric light—that of the maker and of the user. By the application of scientific knowledge and manufacturing skill, new materials and processes have been developed that have greatly increased the efficiency of the original Edisonian product. Likewise those of our industries that have availed themselves of the facilities for improved illumination have increased their own efficiency in operation, reduced hazards and improved working conditions for employees. Those few companies that have not kept pace with the progress of industrial lighting should take advantage of the educational influence of the Golden Jubilee of Light to correct this shortcoming. But regardless of self-interest all chemical engineering industries should give support to this tribute to Edison, the man whose genius has made industry more productive and the world a better place in which to live.

Economic Penalties of Low Commodity Stocks

ONE OUTSTANDING economic change since the World War has been the speeding up of the movement from producer to ultimate consumer of all kinds of goods. This speed, which has been made possible by improved transportation, has permitted hand-to-mouth buying to increase with a certain measure of safety. It has resulted in the maintenance in the hands of both distributors and consumers of exceedingly small stocks of many commodities.

Until recent months almost no voice has been raised against this practice. Almost all comments have commended it, often in exaggerated terms. But the wild orgy through which the copper market has recently passed raises a real question as to whether or not American industry has passed beyond the safe limit in lowering visible stocks of certain goods.

In the field of both heavy and fine chemicals there is need for reconsideration of this subject. Producers and consumers must carefully determine the most economic point in total stock for each commodity, as well as for each concern producing or using that commodity. It makes relatively little difference whether the stock of caustic or acid, for example, be in the hands of the producer or of the user. It is important, however, that this stock be up to some reasonable normal, lest a sudden change in buying or using conditions produce abrupt changes in price that will be detrimental to all substantial interests among both producers and users.

For each of the major chemicals used by American industry there is a small number of principal consuming groups. It will be well if each such group occasionally reconsider its commodity status with reference to the others and with reference to the producing trade. Sometimes such studies may reveal an opportunity further to curtail visible stocks; for example, with commodities the production of which may be speeded up on short notice to meet sudden increases in demand. In other cases the result undoubtedly will be a decision to carry slightly greater stocks on hand, in order that there may be stabilization in supply, stabilization in price, and the maximum over-all producing and distributing economy.

Users Must Concur in Safe Practices

FROM all of the evidence that has come out of the Cleveland Clinic disaster, one certainty at least has appeared. The accident with its appalling loss of 126 lives need never have happened and would not have occurred if regulations such as those set up by the National Board of Fire Underwriters had been adhered to. The evidence has shown beyond a doubt that nearly every provision of the regulations had been overlooked in the storage room for X-ray film at the Clinic.

It has been established that about 7,000 pounds of nitrocellulose X-ray film was stored in the one-time coal room of the Clinic. Among the regulations for storing such quantities appear the following: Storage rooms should be provided with sprinkler systems. No film should be stored closer than 2 ft. from a steam pipe. Rooms should be heated only with hot water or low-pressure steam. Lighting should be provided only by means of guarded incandescent lamps or lamps inclosed in vapor-proof globes; and no extension lights should be permitted under any circumstances. In addition, rooms should if possible be isolated, as for example on a roof, and above all should be completely out of communication with other parts of the building. Vents to the atmosphere, normally held shut by fusible links, are imperative.

The facts have shown that not one of these regulations was observed. The storage room was in communication with the entire building through a heating tunnel and numerous ducts for pipes which rose from the tunnel. This permitted a clear passage for the gases to the space beneath the roof as well as infiltration into every room, so far as is known. For some reason which is not entirely clear the automatic fire door was unable to close. The room was provided only with unguarded extension lights, one of which appears to have been lighted and in contact with a pile of film during the two hours the steam fitter was absent from the room.

There was no sprinkler system and no vent to the atmosphere, except through a sealed coal chute. Film was stored within a foot of a 65-lb. steam line, all of which co-operated in most unfortunate manner to create a disaster of the first magnitude. Once decomposition had started there was nothing to stop it and gases were evolved at a great rate to explode twice within the cellar and once in the space above the fourth story, collapsing the ceilings in many of the rooms.

Immediately after the disaster a number of investigations were commenced; two of the most important were

by Major-General H. L. Gilchrist, Chief of the Chemical Warfare Service, and R. D. MacLaurin, Commissioner of Trade Waste for the City of Cleveland. It was found in Dr. MacLaurin's investigation that the probable starting point for the explosion was the decomposition of a small amount of film by heat from a pendant electric light bulb which touched a pile of film. Analysis was made of water contained in the fire extinguisher which the steam fitter had used. The water had evidently filled the extinguisher when the firemen were flooding the building and it was found to contain large concentrations of carbon monoxide and nitrogen peroxide with a smaller amount of hydrogen cyanide.

When combustion of similar film was tried under conditions thought to reproduce those in the storage room, the investigation found all of these gases as well as nitric oxide formed in concentrations more than lethal, based on the Clinic volume.

Immediately after General Gilchrist's return from Cleveland a group of technologists was assembled and put to work at Edgewood Arsenal. It developed that film could be decomposed by heat from a steam pipe or light bulb at a temperature as low as the boiling point of water, provided the exposure was sufficiently long. Although no mention was made of hydrogen cyanide as being a probable constituent of the gases, the report concurs with Commissioner MacLaurin's in finding the other constituents formed in large quantities.

Both groups stressed the Clinic's failure to meet the regulations for film storage, and agreed that proper precautions would have resulted in only slight damage had a fire started under ideal conditions. The lesson is plain: whether or not the city and the manufacturer are in a measure responsible, there is no avoiding a necessity on the part of the user of dangerous chemical materials for the employment of all safe practices.

A New Job for Chemical Engineers

A MOST interesting experiment is to be tried at Cleveland. This city is under the city manager form of administration, making it easy to divorce city control from politics. Hence a logical extension of the theory that industrial rather than political methods should rule in the city as well as the plant calls for technical supervision and control of all fire hazards throughout the city. Cleveland is fortunate in possessing already the nucleus of the organization required for such work, in the division headed by Dr. R. D. MacLaurin, Commissioner of Trade Waste. This division, at present unprecedented in the country, is to be still further increased in chemical engineering personnel so that it may include in the scope of its activities the control of all storage and handling of chemical materials and products within the city, as well as provision of suitable gas masks and protective devices for firemen.

From the perhaps biased viewpoint of the chemical engineer, it would seem that chemical reactions, such as these fire hazards surely are, should be under the supervision of chemical engineers. It is not apparent why firemen who have little or no chemical knowledge should be considered qualified for the highly technical job of fire warden where chemical hazards are concerned. The entire country should watch the Cleveland experiment with more than passing interest.

Hydrogenation of Petroleum

Promises Revolutionary Development for

AMERICAN INDUSTRY

By S. D. Kirkpatrick

Editor, Chem. & Met.

IN AN editorial in its May number *Chemical & Metallurgical Engineering* offered the opinion that the formation of the American I. G. Chemical Corporation would shortly open up new opportunities for the growth and development of American chemical industry. This view is more than substantiated by facts which are just now becoming known in regard to the almost revolutionary possibilities in the hydrogenation of petroleum. This process, which had been developed by the I. G. Farbenindustrie for German conditions as an outgrowth of coal hydrogenation, has been adapted to the petroleum industry on a commercial scale by the chemical engineers of the Standard Oil Company (New Jersey). By this high-pressure, high-temperature, catalytic process, fuel crudes and the heavy residues of the ordinary refining process can be converted almost quantitatively into gasoline or other more valuable petroleum products. A semi-commercial plant has been in successful operation at Baton Rouge, La., for about a year, and construction is now going forward on the first of two large plants that will compare in output with an average oil refinery.

In the opinion of those who have closely followed the course of the hydrogenation development, this process will take rank as a scientific and commercial achievement along with Baeyer's original synthesis of indigo and Dr. W. M. Burton's introduction of the cracking process to the petroleum industry. Hydrogenation marks the first substantial move toward the application of the basic principles of chemical synthesis in the petroleum industry. Heretofore, in cracking practice, gasoline has

been produced by a *destructive* rather than *constructive* reaction. Now, by the introduction of hydrogen under pressures upward of 100 to 300 atmospheres and in the presence of a catalyst, it is possible to build up or synthesize the hydrocarbons desired and thus to convert approximately 100 per cent of the original oil into gasoline or other products of more value. Carbon formation is actually eliminated and the production of fixed gases is reduced to a minimum. Thus the chemical engineer has again demonstrated that in large measure true conservation of our oil resources lies in their scientific utilization. This process alone promises to make more valuable millions of barrels of low-grade fuel oil and refinery residues.

RESEARCH that led to this development began in 1927. The Standard Oil Company (N. J.) in the fall of that year reached an agreement with the I. G. Farbenindustrie for a joint research on the catalytic hydrogenation process. Details of the arrangement were not made public at that time and it was generally believed that the Standard Oil Company (N. J.) was merely setting aside an investment for the far distant future when oil would be made in the United States by the liquefaction of coal. It now appears that the main object was to test the application of the German process to oil refining under American conditions.

As an answer to the question of German domination through technical personnel which was raised in some quarters against the American I. G., it is of interest to



observe the way in which American chemists and American engineers in the United States and German chemists and German engineers in Germany have co-operated in this development. The research program of the Standard Oil Company (N. J.) has been carried on by the Standard Oil Development Company, both in the company's engineering laboratories at Bayway, N. J., and at the Baton Rouge refinery of the affiliated company, the Standard Oil Company of Louisiana. The larger group of chemical engineers responsible for carrying the development through to plant scale operation has been working at Baton Rouge.

Starting with the knowledge gained by developments in Germany, further laboratory and semi-commercial plant scale experiments were undertaken by a group of over one hundred and fifty American chemists, engineers and skilled mechanics. This group of American workers has co-operated with, and in turn has been greatly helped by, the research and engineering staffs of the I. G. Farbenindustrie. The work in this country, however, has been a strictly American development. The plants now under construction utilize what are reputed to be the largest ingot forgings of alloy steel that have ever been fabricated in the United States. These forgings are made by an American firm according to the specifications laid down by the development engineers who have studied the high-pressure and temperature requirements of the process.

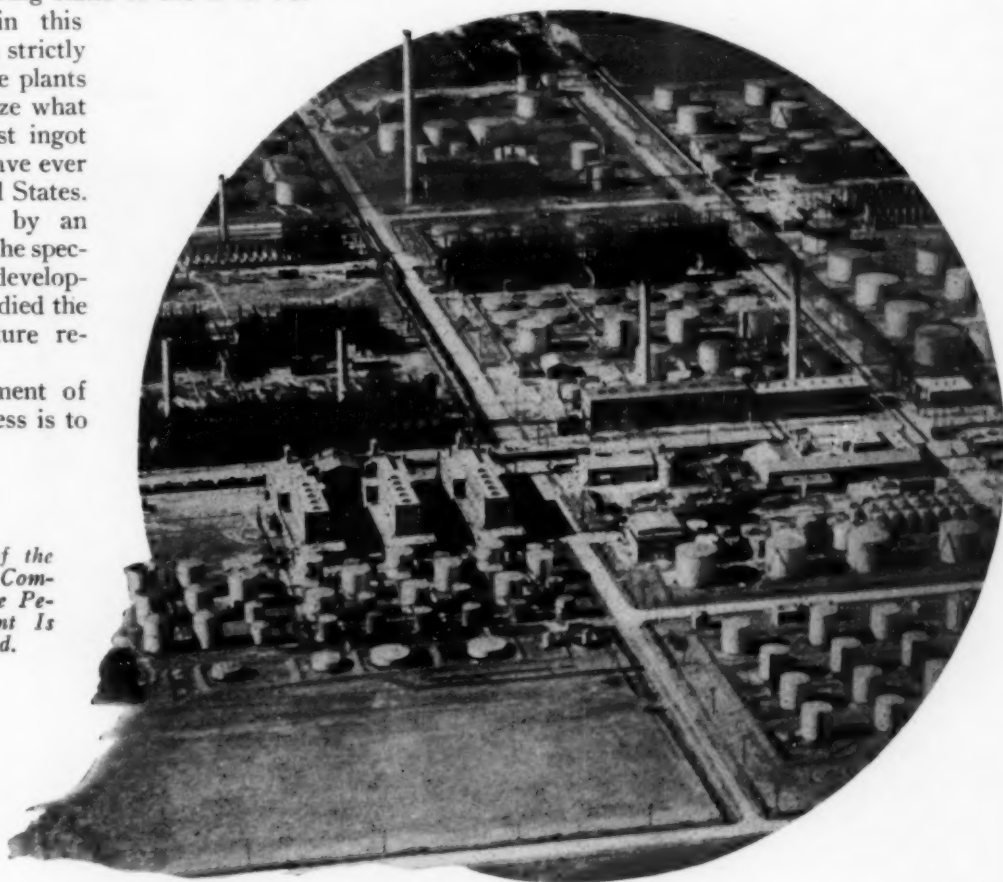
The commercial development of the new hydrogenation process is to

be carried on by the Standard Oil Company (N. J.) entirely independent of and without any reference to the American I. G. Chemical Corporation. As a matter of fact neither the Standard Oil Company (N. J.) nor its subsidiary or affiliated companies have any interest in the American I. G. Mr. Teagle's position on the board of directors of the American I. G. is undoubtedly a purely personal interest.

Reports from Germany indicate that it is confidently expected there that an agreement will shortly have been reached whereby the German I. G. Farbenindustrie transfers to the Standard Oil Company (N. J.) all of its interest in hydrogenation and liquefaction of coal, oil and allied products. This agreement will cover all countries in the world except Germany, where the I. G. will retain its hydrogenation rights.

Right—A Section of One of the Refineries of the Standard Oil Company (N. J.) Where a Large Petroleum Hydrogenation Plant Is Shortly To Be Constructed.

Below—A View of the Leunawerke of the I.G. at Merseberg Where More Than a Thousand Tons of Coal a Day Is Being Hydrogenated to Produce Motor Fuel.



Cleveland Clinic Disaster

Has a Lesson for Chemical Industry

EDITOR'S NOTE—Had the Cleveland Clinic observed the safe practices outlined in the "Regulations of the National Board of Fire Underwriters for the Storage and Handling of Photographic and X-ray Nitrocellulose Films" this tragedy would never have occurred. The user cannot evade responsibility for flagrant violations of these regulations for the public safety, but the manufacturer of nitrocellulose products has an obligation to educate the user to the character of the hazards involved in the decomposition of nitrocellulose, whether as film, plastic or lacquer.

CHEMICAL engineering investigation has revealed an unguarded electric light bulb as the likely cause of one of the most serious catastrophes in the history of nitrocellulose. More than 50,000 nitrocellulose X-ray films, weighing in the aggregate about 7,000 lb., had been stored in a basement room in the four-story concrete building of the Cleveland (Ohio) Clinic. Although of fireproof construction, the room was not ventilated nor was it equipped with automatic sprinklers. When, on May 15, the heat from the bulb started the decomposition of the film, great volumes of poisonous and explosive gases were generated and, because of the construction of the building, these quickly permeated the entire structure. The gases ignited and there were subsequent explosions. Of 225 occupants of the building nearly 100 were killed immediately and a great many were so severely injured by the fire or the poisoning effects of the gas that by June 1 the death list had reached 126.

The room in which the film was stored was about 25x20 ft., unsprinklered and without vents to the outside. Most of the films were 14x17 in. and were kept in manila paper envelopes, which were piled on open wooden shelves or placed in ordinary metal letter files. The room was lighted by electric bulbs on pendant cords some of which hung down directly in front of the film stacks. A 4-in. steam line, carrying a steam supply at 65 lb. pressure, also passed overhead through the film room.

The Factory Mutual Record of the Associated Factory Mutual Fire Insurance Companies, of Boston, has reported the events leading up to the accident in the following paragraphs:

At about 9 a.m. on Wednesday, May 15, a steam fitter was called to repair a leak in the steam pipe in the coal room, just above the film shelves. He removed the covering from the pipe and, finding it too hot to work on, went over to the hospital to have the steam shut off. Returning about 11:15, he entered the room and saw a small cloud of brownish gas, which he mistook for smoke, at the ceiling above the film storage. He obtained a soda-acid extinguisher and directed it at what he supposed was a fire, but the gases rapidly increased in intensity and drove him from the room, the door of which he left opened. He escaped from the basement through a window.

A few minutes after the first discovery of trouble, an explosion occurred in the basement. This may have resulted from the formation of an explosive mixture of the gases with air or, more likely, a gigantic puff as the gases burst into flames spontaneously from the increasing heat of decomposition. Just outside the film-room door was an automatic gas water heater, the pilot light of which was undoubtedly lighted and might have ignited the gases.

A second explosion soon followed in the basement. Then ten minutes later a violent explosion in the hollow space beneath the roof blew down the ceiling of many of the top-story rooms and lifted the roof skylight. An explosive mixture of the gases and air in the roof space was probably ignited by fire which flashed up one of the ducts.

Of several investigations of the cause of the disaster, one of most interest from a chemical engineering standpoint was that conducted for the City Manager of Cleveland under the direction of Dr. R. D. MacLaurin, Commissioner of Trade Wastes. Dr. MacLaurin was assisted by Dr. M. H. Veazey and Dr. C. H. Saylor, of the Division of Trade Wastes, as well as by M. M. Braidech,

chemist for the city water department. The testimony of these men before the City Commission on June 4 established the fact that an extension cord with a 100-watt electric bulb had been suspended from a two-way socket attached to a steam pipe directly over the wooden film shelves in such a way that the bulb was in direct contact with the films. The extension cord and the bulb were found intact by Dr. MacLaurin in the debris. When replaced in its original position, as shown in the accompany-



**Within the Film Storage Room Where
the Fatal Fire Started**

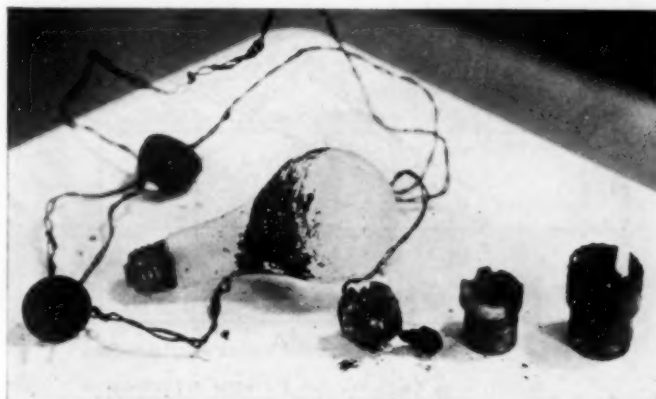
Suspended from the steam line overhead is shown in reconstructed position, the original electric light bulb that is believed to have started the decomposition of the thin edges of the film with which it came into direct contact.

ing photograph, the bulb touched the films on the file 7½ in. from the floor. It was established by Val. Hausmann, electrical engineer for the city, that both the two-way socket and the switch of the bulb socket were in the "on" position when found.

Braidech and Saylor described tests that seemed to prove conclusively that the electric bulb rather than the steam pipe or escaping steam was responsible for the fire. Films held in contact with the 100-watt bulb ignited in from 2 to 17 minutes. The bulb was shown to produce a temperature of 440 deg. F. It is of interest to note that when the electric light bulb was covered with an ordinary steel guard it failed to ignite films held one-half inch away during a 5-hr. test.

In a second series of tests high-pressure steam at 315 lb. pressure and 150 deg. superheat was discharged into a box containing nitrocellulose films which was held at a distance of 10 in. The temperature of the steam in the line was 565 deg. F. and at the point of contact with the film it was about 250 deg. F. There was a slight discoloration of the film but no decomposition at the end of 10 minutes.

Much popular as well as technical interest centered in the nature of the gases produced by the decomposition



This 100-Watt Bulb Was Found in an "On" Position in the Debris Immediately Below the Two-way Socket. The shape of the bulb and the markings on it indicate clearly its contact with the burning film.

of the film. Quantitative tests were made by Dr. Veazey to show the quantities of nitrogen oxides, carbon monoxide and hydrogen cyanide generated. The following is quoted directly from his testimony before the city commission:

Table I—Gases Produced in Decomposition of Cleveland Film

	A. With Insufficient Air for Complete Combustion		B. In Atmosphere of CO ₂	
	No. 1	No. 2	No. 3	No. 4
Weight film.....	0.359 gr.	0.330 gr.	0.497 gr.	0.451 gr.
Total Vol. gas.....	69.4 cc.	61.3 cc.	81.8 cc.	76.7 cc.
Vol. NO.....	24.7 cc.	20.8 cc.	47.7 cc.	46.7 cc.
Per cent by Vol. of NO.....	35.6 per cent	34.0 per cent	58.2 per cent	60.9 per cent
Vol. CO.....	23.6 cc.	21.6 cc.	31.3 cc.	27.7 cc.
Per cent Vol. of CO.....	34.0 per cent	35.2 per cent	38.3 per cent	36.2 per cent
Vol. HCN.....	0.60 cc.	0.63 cc.	2.8 cc.	2.3 cc.
Per cent of HCN.....	0.86 per cent	1.00 per cent	3.5 per cent	3.0 per cent
			Vol. Residue.....	
			Per cent.....	

Note: After decomposition of the film the gases were washed into a nitrometer by means of CO₂ from NaHCO₃ and were collected over approximately 10 per cent NaOH. Volumes given are for dry gas at 0 deg. C. and 760 mm. HCN was not included in total volume.

Table II—Gas Produced from 7,000 Lb. of Film and Estimated Concentration in Clinic Atmosphere

	Decomposed in Some Air		Decomposed in Carbon Dioxide	
	No. 1	No. 2	No. 3	No. 4
(a) Volume NO 0 deg. C.—760 mm.....	7,700 cu.ft.	7,100 cu.ft.	10,800 cu.ft.	11,500 cu.ft.
(b) Volume NO 20 deg. C.—740 mm.....	8,470 cu.ft.	7,810 cu.ft.	11,900 cu.ft.	12,650 cu.ft.
(c) Parts per million based on (b).....	25,000 p.p.m.	23,000 p.p.m.	35,000 p.p.m.	38,000 p.p.m.
(d) Volume CO 0 deg. C.—760 mm.....	7,350 cu.ft.	7,350 cu.ft.	7,100 cu.ft.	6,900 cu.ft.
(e) Volume CO 20 deg. C.—740 mm.....	8,085 cu.ft.	8,085 cu.ft.	7,800 cu.ft.	7,600 cu.ft.
(f) Parts per million based on (e).....	24,000 p.p.m.	24,000 p.p.m.	23,500 p.p.m.	23,000 p.p.m.
(g) Volume HCN 0 deg. C.—760 mm.....	187 cu.ft.	208 cu.ft.	.....	.....
(h) Volume HCN 20 deg. C.—740 mm.....	208 cu.ft.	229 cu.ft.	.....	.....
(i) Parts per million based on (h).....	585 p.p.m.	655 p.p.m.	.....	.....

In a separate determination, a concentration of hydrogen cyanide equal to 1,330 p.p.m. was obtained.

Films held in contact with a 100-watt bulb ignited in from 2 to 17 minutes



Steam at 315-lb. and 150 deg. superheat failed to decompose the films.

Tests Used to Prove That the Light Bulb Rather Than the Steam Caused the Initial Decomposition

Two methods were employed to determine the quantities of nitric oxide and of carbon monoxide formed by the decomposition of film material. First, small pieces of film were decomposed by heat in the presence of insufficient air for complete combustion. All of the gases insoluble in 10 per cent sodium hydroxide were collected and nitric oxide and carbon monoxide were determined. Determinations of hydrogen cyanide were made in the alkaline solution. Second, the same procedure as above was carried out, except the hydrogen cyanide determination, in an atmosphere of carbon dioxide. This inert atmosphere was thought to resemble to a certain extent the conditions at the Cleveland Clinic after the air had been driven from the film room.

Table I gives the results of four determinations carried out on Cleveland Clinic film. It is apparent that in the atmosphere of carbon dioxide the percentage by volume of nitric oxide is much higher than when a small quantity of air is present. The cyanide though small in comparison to the two oxides, is not to be ignored.

A calculation has been made of the quantities of nitric oxide, carbon monoxide and hydrogen cyanide formed on the basis of 7,000 lb. of film decomposing. Table II gives the results. There is also included another calculation. On the basis of the volumes of the gases obtained, and assuming the clinic to have an inside space of 350,000 cu.ft. through which the film gases are assumed to be uniformly distributed, the concentrations in parts per million are given.

It will be observed that all of these gases are in more than lethal concentrations.

Calculating the Specific Heats of Hydrocarbon Vapors

By *W. K. Lewis and W. H. McAdams*

Department of Chemical Engineering
Massachusetts Institute of Technology
Cambridge, Mass.

DESPITE the technical importance of the specific heat of hydrocarbon vapors, the dependable data on the subject are extremely limited. Engineers not infrequently use the specific heat of the liquid as that of the vapor, despite the fact that the indications of both logic and analogy are that this is indefensible. Based on a study of the literature and certain preliminary measurements, the authors are using, for the moment, a tentative expression for the heat capacities of paraffin hydrocarbon vapors which is believed of sufficient importance to justify its use until more adequate and comprehensive data are available.

The great majority of determinations hitherto made have been by an indirect method based on the velocity of sound. Unfortunately, this method loses precision as the molecular weight and consequently the molal heat capacity of the vapor increases. Data thus obtained for methane probably are satisfactory, but for hydrocarbons above ethane large errors are likely to develop, which may easily rise to 10 per cent or more. Consequently, in correlating indirect data from the literature, far more weight should be given to measurements on hydrocarbons low in the series.

SUPPLEMENTING data of the literature, Beren and Brown, of Massachusetts Institute of Technology, have recently made a series of preliminary direct determinations of the specific heats of propane, butane and a mixture of ethane, propane and butane, the average molecular weight of which was measured. (Undergraduate Chemical Engineering Thesis, 1928, M.I.T., Cambridge, Mass.) The calorimeter used employed steady flow of the gases through a coil immersed in an electrically heated bath. The input of electrical energy necessary to produce a definite temperature rise was determined, and the rate of gas flow was measured by a gasometer. The temperature range of these determinations was approximately 25 to 75 deg. C. The calorimeter was calibrated against hydrogen, air and methane, giving results checking data from the literature within two per cent or less. The results of the direct experimental determinations on propane and above, average 10 to 20 per cent higher than the indirect values which are given in the literature for these hydrocarbons.

The following equation is proposed as best representing the data now available for the molal heat capacities of paraffin hydrocarbon vapors at low pressures:¹

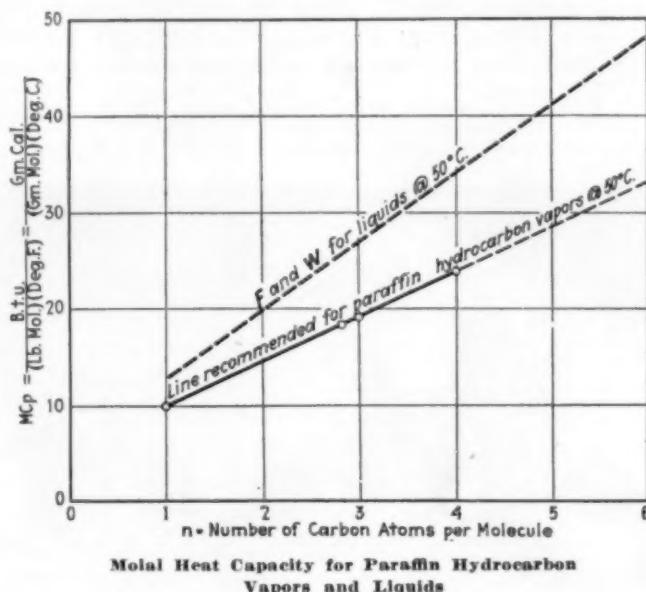
$$MC_p = 4.4 + 4.4n + (0.012 + 0.006n)t, \text{ where } t \text{ is deg. C.,}$$

$$MC_p = 4.19 + 4.29n + (0.0067 + 0.0033n)t, \text{ where } t \text{ is deg. F.}$$

In these expressions, n is the number of carbon atoms per molecule, and MC_p is the molal heat capacity, ex-

pressed as B.t.u. per pound mol per degree Fahrenheit, or gm. cal. per gm. mol per degree Centigrade. In determining the coefficients, the only high-temperature data (up to 600 deg. C.) are for methane.

While the coefficients of the equation as given fit the temperature effect reported for higher hydrocarbons, for these the temperature level of measurement is too low to obtain good precision in determining the temperature coefficient. While it is believed that the equation adequately allows for the influence of molecular complexity in the neighborhood of normal temperatures, data at higher temperature levels are lacking. The equation breaks down at low temperatures and should not be used below zero Centigrade. Furthermore, the data were all obtained at substantially atmospheric pressure. At higher pressures, deviations will develop and at very high pressures these may become serious. This equation is based



on the data for paraffin hydrocarbons only, and should not be applied to other hydrocarbons. Thus, if used for ethylene, acetylene or benzene, the equation would give values 25 to 40 per cent higher than the values quoted in the literature; these discrepancies are connected with the deficiency of hydrogen in these compounds.

THE FIGURE here shows the direct determinations of the molal heat capacity of the vapor of paraffin hydrocarbons at 50 deg. C., plotted against the number of carbon atoms per mol. The lower line shows the recommended equation for vapors, and the higher line shows the molal heat capacity for the corresponding liquid hydrocarbons, based on the equation of Fortsch and Whitman (*Ind. Eng. Chem.*, Vol. 18, page 795, 1926). It is seen that the equation for liquid hydrocarbons is 25 to 45 per cent higher than the values for the hydrocarbon vapor.

It is believed that the above equation is the most dependable now available to represent the heat capacities of the vapors of the low molecular weight hydrocarbons of the paraffin series, at atmospheric pressure. It is worthy of note that the equation is directly applicable to mixtures of vapors of these hydrocarbons by using the average value of n for the hydrocarbon mixture, as may be determined by ordinary methods of vapor-density measurement.

¹Data of the following authors were used in determining the coefficients of this equation: Heuse, *Ann. d. Phys.* (4) 59, 86, 1919; A. Daniel and P. Pierron, *Bull. Soc. Chim.* (3) 21, 801, 1899; Capstick, *Proc. Roy. Soc.* 54, 101, 1893; R. W. Millar, *J. Am. Chem. Soc.* 45, 874, 1923; F. A. Glacchini, *Phil. Mag.* (6) 50, 146-156, 1925; H. B. Dixon and G. Greenwood, *Proc. Roy. Soc. (A)*, 105, 199-220, 1924; Capstick, *Phil. Trans. (A)* 185, 1, 1894; Partington and Shilling, "The Specific Heats of Gases", Van Nostrand, 1924.

Recent Developments Discussed by Electrochemists

Industrial conference features meeting of
American Electrochemical Society at Toronto

Editorial Staff Report

WHAT proved to be a record meeting of the American Electrochemical Society both in attendance and in reports of new processes and products, was held during the last week of May at Toronto, Ontario. The University of Toronto had very generously put at the disposal of the A.E.S. members and guests the dormitories, lecture halls and the world-famous Hart House, where all of the meals were served. The unparalleled success of the meeting was in very large measure due to Prof. William Lash Miller and his able local committee. Besides the attractions of the technical sessions were the social functions and the visits to industrial plants in Toronto and Port Colborne. The most interesting of these was the visit to the new refineries of the International Nickel Company.

The last week of May was Chemical Convention Week for the Dominion and both government and railroad companies co-operated to swell the attendance. Besides the sessions of the A.E.S. there were sessions, both separate and joint, held by the Canadian Chemical Association, the Canadian Institute of Chemistry and the Canadian sections of the Society of Chemical Industry.

THE convention formally opened Monday morning with a session devoted to papers on the electro-magnetic characteristics of electrochemical processes. Among the papers that aroused considerable interest was J. W. Shipley's report of his investigation on electric boilers. The author determined the rate of generation of electrolytic gases using sodium hydroxide as electrolyte, and with frequencies from 0 to 300 cycles, for a.c. electrolysis of water, using platinum, copper and silver electrodes.

He found that arcing, with its accompanying decomposition of water, can be suppressed by applying external pressure, and thus preventing the formation of steam bubbles on the electrodes. This suggests that electric boilers should operate under pressure, and the hot water be permitted to boil in a second chamber at a lower pressure.

In discussing Shipley's findings, W. D. Bancroft, of Cornell University, referred to the importance of taking into account the catalytic effect of the platinum black when using platinized electrodes. In answer to F. A. Lidbury's inquiry regarding the corrosion of the electrodes Shipley stated that above the critical current density corrosion becomes pronounced and that carbon electrodes then decompose rapidly.

Teachers from all over the continent attended a very

profitable session on the afternoon of May 27. Roy L. Dorrance of Queen's University had invited authorities in America and abroad to present their views as to the best means and methods for teaching electrochemistry. Professor Dorrance and others believed in a thorough grounding in mathematics and physical chemistry. He also felt that the history of electrochemistry should be included in any well-rounded course. Although he was heartily supported on this point by J. Lyman Sheean, of Culver Military Academy, many others believed that the time for historical studies was after graduation. Louis Kahlenberg, in his characteristic forceful manner, emphasized the importance of thorough laboratory instruction.

The paper by M. de Kay Thompson described the course in electrochemistry at the Massachusetts Institute of Technology. C. G. Fink, of Columbia University, compared with this his course and supported Dr. Kahlenberg in his view as to the importance of laboratory instruction. C. J. Brockman, of the University of Georgia, lamented the absence of instruction in organic electrochemistry in most of our colleges. A detailed exposition of the progress in teaching electrochemistry in England was submitted by E. O. Jones, of the University of Manchester, England. There are only two English colleges which have definite specialized courses in electrochemistry, Imperial College and Manchester.

Following these discussions Henry C. Parker, of the U. S. Patent Office, argued in favor of having students become familiar with standard electrical measuring instruments in place of the laboratory type in order that when these students enter a technical or industrial laboratory, they will be fully conversant with the instruments there used. Parker's paper aroused considerable discussion, and although Dr. Frary and Frederick J. Hambly, of Quebec, agreed that students ought to be familiar with standard instruments, Kahlenberg, Warner and Bancroft argued that Parker's idea was not entirely sound.

THE importance of electrochemistry in the teaching of analytical chemistry was emphasized by N. Howell Furman, of Princeton University. William Blum, of the Bureau of Standards, pleaded for better instruction in the use of equivalents and the appreciation of significant figures. James T. Burt-Gerrans described the courses given by Professor Miller and himself at Toronto University, stressing the importance of having

the students themselves determine the Faraday constant and other values frequently met with in electrochemical research. An improved graphical method of teaching the thermochemistry of high temperatures was presented by Alfred Stansfield.

An unusually large audience was attracted to the informal discussion of various industrial topics. R. A. Witherspoon, vice-president and general manager of the Canada Carbide Company, presided and conducted the meeting in admirable fashion. The first paper of the meeting was presented by Farley G. Clark, of the Clark Electrolytic Cell Syndicate, in which he discussed the base-load central station and its future relation to the electrochemical industry. He stated that there are available in the United States and Canada large quantities of surplus energy, at costs varying from 0.12 to 0.35 cent per kilowatt-hour, and this surplus energy can be converted into a steady supply of a readily usable commodity, namely, oxygen and hydrogen gas, by the hydrolysis of water. The manufacture and sale of these gases should become a normal function of utility companies. At 0.12 cent per kilowatt-hour the two gases together will cost 22 cents per 1,000 cu.ft.

FOLLOWING Clark's paper George W. Malone of Reno, Nev., briefly described the new Boulder Dam project and pointed out the advantages of Nevada for a new electrochemical industrial center. Interesting papers were then presented by F. A. Fitzgerald, of Niagara Falls; by R. J. Traill and W. R. McClelland, of the Canadian Department of Mines, and by N. K. G. Tholand, of New York. Mr. Tholand described his work on sponge iron, a raw material for electric steel, and with the aid of carefully prepared tables on costs, properties of products, etc., he was able to show the advantages of sponge iron over other raw materials such as pig or scrap. He stated that sponge iron is now commercially produced in Sweden. It should be considered as a base for the manufacture of commercial and highest grade steels. This form of iron can be made free from silicon and very low in carbon, sulphur and phosphorus. The physical properties of steels made with sponge iron excel those of steels made from scrap or pig iron.

The evening of the first day of the A.E.S. convention was devoted to a general session, open to the public. Prof. Harry A. Curtiss, of Yale University, reviewed the various nitrogen-fixation processes and submitted interesting data collected during his extensive travels abroad.

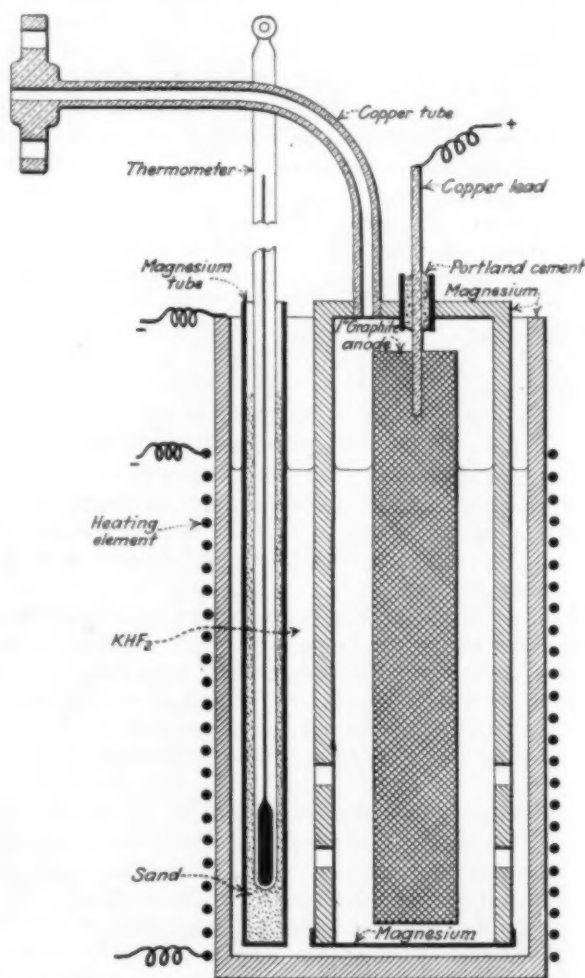
The session on Tuesday morning was presided over by President Paul J. Kruesi and was devoted to reading and discussing ten splendid papers. The outstanding contribution at this session was that on fluorine. Some years ago F. C. Mathers devised a cell that would turn out fluorine gas in large quantities, something that had never been done before. Now Professor Bancroft and Newton C. Jones, of Cornell University, undertook a systematic investigation of the properties and applications of this comparatively new gas. The gas was produced by electrolyzing fused potassium hydrogen fluoride in the Mathers cell, using a magnesium metal pot as cathode and a graphite rod as anode. These investigators were able to obtain about 250 c.c. of fluorine gas per ampere-hour from the cell and stated that it has been in operation for more than a year. Experiments were then carried out to study the reactions of fluorine with various substances. They found that fluorine oxidizes solutions of cobaltous, chromic, manganous, and plumbic salts.

When fluorine attacks organic compounds it must displace the least negative radical, or combine with the most positive radical. A new though undeveloped technique for studying organic compounds is thus opened up. When fluorine is brought in contact with benzene vapor there is an induction period, after which the reaction proceeds explosively.

DISCUSSING the fluorine paper, Fr. Fichter, of Basel, Switzerland, questioned whether the charging of a cation from a lower to a higher degree can be effected without the intervention of an oxygen furnishing compound. He has not so far succeeded in transforming manganous sulphate to permanganic acid, or of chrome alum to chromic acid without the aid of oxygen.

Following this H. C. Kremers and L. L. Quill, of the University of Illinois, described their investigation covering the fractional hydrolysis of rare earths by electrolysis. The authors gave an interesting description of their studies of the separation of yttrium from holmium and erbium, and the relation of yttrium to the cerium group earths. From the standpoint of time, convenience and quantity of material to be fractionated, this method was found to be superior to most ordinary fractionation methods, depending upon relative basicities.

As usual the topic of corrosion incited much heated discussion and it was difficult for President Kruesi to limit the time assigned to those participating in the debate. In the absence of Ulich R. Evans of Cambridge, England; F. N. Speller, of Pittsburgh, presented Evans'



Mathers' Cell for the Production of Fluorine

paper on the electrochemical corrosion of painted or lacquered steel, in which the author stated that when a drop of water rests on a steel sheet, protected by an imperfect coat of varnish or paint, the sodium hydroxide, formed as the cathodic product around the edges of the drop, may produce alteration or loosening of the coat, so that it can be removed by quite gentle rubbing. The loosening may extend over an area far exceeding that originally covered by the drop, owing to the creepage of the alkali over the metallic surface.

Salts which do not produce caustic alkali have comparatively little action. The peeling occurs only if there is some slight porosity or imperfection in the paint which allows a minute amount of corrosion, but an amount of corrosion which would be harmless in its direct effect, may nevertheless cause stripping over a large area. The nature of the metallic surface affects the result, while different varnishes and paints behave quite differently from one another. It is impossible to forecast the liability of a coat to "alkaline peeling" from its appearance, or from the degree in which it protects the metals from corrosion. Certain linseed varnishes, containing copal, are less susceptible to peeling than corresponding mixtures without copal. The introduction of certain pigments into the coat also reduces the danger of peeling, either by strengthening the coat, diminishing the permeability, or by keeping the metal passive.

R. M. Burns and W. E. Campbell, of the Bell Telephone Laboratories, developed a new electrical resistant method for measuring corrosion of lead by an acid vapor. Extruded lead was used and the corrosive media were atmospheres in equilibrium with concentrations of acetic acid ranging from 0.00001 to 0.02 molar. The method was applied by the authors to the problem of comparing the corrosiveness of different wood sawdusts, and results were obtained which correlate closely with laboratory tests, on wood acidity and with field experience.

THE session was closed by the reading of a paper on organic type inhibitors in the acid corrosion of iron by J. C. Warner, of the Carnegie Institute of Technology. Warner studied the effect of various concentrations of gelatine upon the energy required for the deposition of hydrogen on iron, and compared these results with the inhibitor action of gelatine in the acid corrosion of iron. The effect of small quantities of quinoline, aniline, bases from petroleum fractions and bases from coal-tar oils, upon the energy required for the deposition of hydrogen was recorded, and the effectiveness of these substances as inhibitors in the acid corrosion of iron determined. Experiments indicate that any substance which will form a large positively charged oily ion, or a positively charged, oily, colloidal dispersed particle, in acid solution, should inhibit the acid corrosion of iron if the substance cannot be electrolytically reduced.

Duncan McRae presided at the session Wednesday morning, devoted to contributions on the electrodeposition of metals. At this meeting Stewart J. Lloyd, of the University of Alabama, described his research work on the Estelle method of producing electrolytic iron. In 1917-18 Estelle suggested and patented the electrolytic deposition of metallic iron from a suspension of its hydroxide in strong hot caustic soda. His results were confirmed and extended in Lloyd's paper to various ores of iron, and a study was made of the regeneration of the caustic solution by means of lime. This paper was

discussed by Axel Estelle, of Hagan, Westphalia; Robert D. Pike, of Emeryville, Calif.; Benjamin Miller and Dr. Fink, of Columbia University. The general opinion was that further research on the Estelle process is necessary before considering it from a practical point of view.

HERE followed a long discussion of chromium plating and the various means employed for the careful regulation of the bath, so essential to success. Walter L. Pinner and Edwin M. Baker, of the University of Michigan, described their bent-cathode test for determining the ultimate ratio of chromic acid to sulphate in chromium plating baths. They emphasized that the control of the ratio of chromic acid to sulphate is most important in the operation of these baths.

A rapid method of determining the proper quantity of either sulphuric acid or chromic acid, as the case may be, to be added to a bath to produce maximum throwing power, was described. The paper was discussed by Dr. Blum, who referred to researches by O. J. Sizelove, of Irvington, N. J., and stated that it is possible by suitable tests to determine at the same time the appearance of the plate. George B. Hogaboom, of Matawan, N. J., emphasized the importance of the area and polarization of the anode in carrying out the tests.

Cadmium, the competitor of zinc, was considered by L. R. Westbrook, of the Grasselli Chemical Company, in his contribution on the electroplating of cadmium from cyanide baths. The cyanide bath for commercial cadmium plating was discussed from the standpoint of bath composition, increasing the effects of variations in the concentrations of the different constituents on the electric properties of the bath. The marked improvement in the physical properties of the deposit resulting from the presence of a few hundredths of a per cent of nickel, or larger amounts of cobalt or copper in the bath, were emphasized. R. E. Brewer and G. H. Montillon, of the University of Minnesota, discussed their method of measuring the hydrogen ion concentration in plating baths. The electrodes used were hydrogen, oxygen, quinhydrone, antimony, and lead dioxide. Conditions for the best experimental procedure were established, as well as the limitations of the various electrodes, in typical nickel, cobalt, iron, zinc and chromium plating baths. The final paper of the convention was that of G. A. Roush, of Bethlehem, Pa., covering electrochemical equivalents. Professor Roush submitted tables of new values based on the 1929 atomic weights.

THE social events making the meeting doubly attractive included the reception at Government House, the musicale and entertainment at Casa Loma so cleverly arranged by "Sir Austin Lidbury, K. G." and the joint dinner and dance Wednesday evening, one of the most delightful affairs ever held by the society. At this function M. l'Abbé Alex. Vachon, president of the Canadian Chemical Association, and President Kruesi of the American Electrochemical Society addressed the members. The climax of the evening was the election of William Lash Miller to honorary membership in the American Electrochemical Society, the greatest honor that the electrochemists confer. There are but four other honorary members on the society's roll.

The new president of the society is Francis F. Frary, director of the research laboratories of the Aluminum Company of America. Acheson Smith, of Niagara Falls, was re-elected treasurer, and Dr. Fink, secretary.

Modern Practice Crystallized in New Tunnel Kiln

By George S. Housman and Gilbert E. Seil

General Manager,
Lavino Refractories Company
Philadelphia, Pa.

Technical Director,
E. J. Lavino and Company
Philadelphia, Pa.

EDITOR'S NOTE—During the last few years there have been marked improvements in tunnel kiln design. The kiln which is described here was installed by E. J. Lavino and Company, of Philadelphia, during the past few months and has just gone into service. It is, therefore, truly representative of the best in the present-day kiln construction. The kiln is being used for burning chrome and magnesite brick—high-temperature refractories that require a burning temperature of 2,700 to 2,800 deg. F. Only a few years ago such temperatures were believed impracticable for tunnel kiln operation.

FOR several years past the Lavino Refractories Company, a division of E. J. Lavino and Company, of Philadelphia has been producing silica, chrome, and magnesite brick in its plants at Womelsdorf and Plymouth Meeting, Pa. At the latter plant, where the research laboratories of the company are located and where also high-temperature cements and gas-house oxide are made, a continuous tunnel kiln, now of obsolete design, has been in operation for several years. When it was necessary to expand the burning facilities it was decided to install a thoroughly modern kiln which has just now been put into service; and later to replace the original kiln with a duplicate of the new one.

The new kiln was designed and erected by American Dressler Tunnel Kilns, Inc., of Cleveland. It has a capacity of 60 trucks, each holding a maximum of 864 eleven-pound bricks. The daily throughput amounts to approximately 12,000 bricks, or a total of 132,000 lb.



Fig. 1—Entrance End of the Kiln With Transfer Track at the Lower Right

Trucks are pushed through the frame shown in the center of the photograph to insure correct clearance all around. Loaded trucks appear behind the frame.

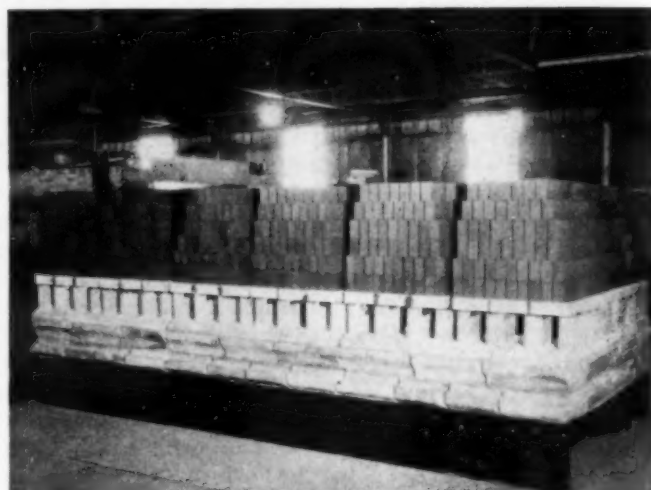


Fig. 2—Group of Three Kiln Trucks Loaded With Green Ware Ready for Burning

Each car has 848 brick loaded upon platforms of silica brick and firebrick blocks. Note the gas passages beneath the upper courses of the platform.

of refractory shapes. The kiln is used for both chrome and magnesite brick and is operated at a maximum temperature of 2,800 deg. F. The temperature of the ware leaving the hot zone is between 2,600 and 2,700 deg. F., and the temperature leaving the kiln is 600 to 700 deg. F.

The total length of the kiln outside is 325 ft. 6 in. This is divided as follows: vestibule, 18 ft.; preheating zone, 104 ft. 6 in.; furnace zone, 123 ft.; cooling zone, 80 ft. Each section will later be taken up in detail. The inside width of the kiln is 7 ft. 9 in., and the height from the rail level to the roof baffles is 6 ft. 6 in. Sand seals are provided at either side of the passage for the entire length of the kiln, as well as side baffles which mesh with projections of the firebrick forming the loading platform support on the trucks. This side seal is single in the cooling zone and double in the furnace and preheating zones.

Materials from which the kiln is constructed vary with the service. The arch varies either way from silica brick in the furnace zone through Furnace Zone Firebrick No. 4, Firebrick No. 1, and No. 2. The upper side walls are of the same material as the arch in each zone. Lower side walls, being cooler, make use of silica brick only for their upper part in the furnace zone, ranging to No. 2 firebrick at the bottom. Other zones range in their hottest parts from furnace zone firebrick to No. 2 firebrick.

Kiln accessories include a 100-ton hydraulic pusher

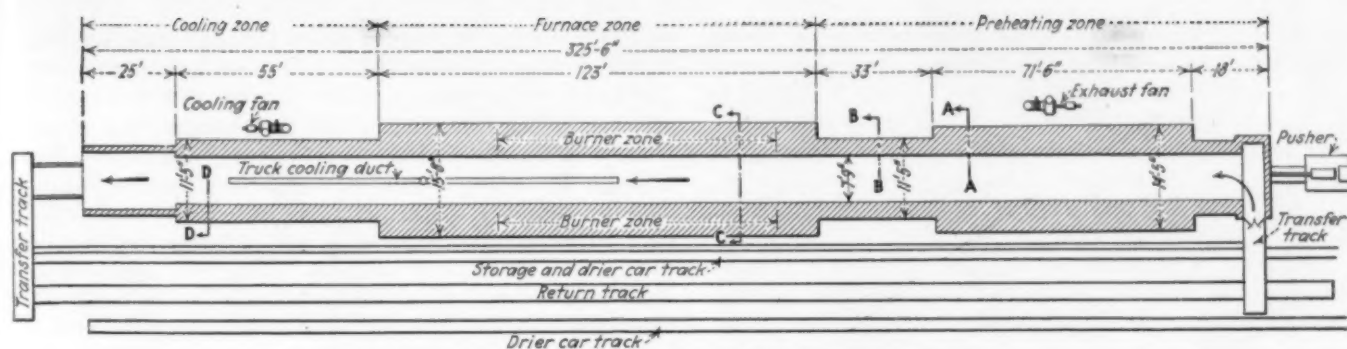


Fig. 3—Plan of the Kiln Showing Principal Dimensions

at the entering end, and recessed transfer tracks at either end carrying the transfer cars. The latter have safety devices for locating the cars with reference to the storage tracks so that a truck cannot be derailed in loading or unloading since the transfer car is locked in place. Entrance to the kiln is effected at the side of the vestibule through a pair of swinging doors and egress from an iron cooling chamber through a rolling steel door at the exit end.

The kiln building is located on uneven ground which slopes sharply from the raw material storage area down to the rail siding. This made it desirable to build a two-story building, utilizing the upper floor for the processing and forming machinery and the kilns, and the lower for storage of the product and shipping. Heavy concrete piers, spaced on 16-ft. centers and designed for 4,000 lb. per square foot, are used to support the kiln weight and still leave ample storage space. The finished brick is loaded upon the skid platforms as soon as it has cooled, and is drawn by electric industrial trucks to the de-elevator and then to storage. A large part of the output is stored upon these skids so that the only handling required is at the kiln and the railroad car.

Steel work, consisting of 9½-in. I-beams for the kiln floor, was laid upon the existing floor. The final floor level outside the kiln, corresponding with the kiln rail level, is approximately 18 in. above the original. This permits extension of the buckstays to a suitable depth below the kiln to provide for the lower tierods and also makes possible the recesses for the transfer car tracks.

The kiln is direct-fired, using 528 B.t.u. city gas for fuel. Atmospheric air is forced through the cellular

walls of the cooling zone into the kiln interior, where it cools the ware and passes at a temperature of about 2,000 deg. F. to the burners. This supplies all of the combustion air. Combustion takes place at the burners and in the spaces beneath the loading platforms and the products of combustion travel through the ware toward the preheating end, heating the incoming ware to about 2,000 deg. F. Exit of the gases is made through openings in the side walls from which the gases are vented to the atmosphere at a temperature of about 500 deg. F. by a fan.

The preheating zone, with the exception of a section 33 ft. long adjoining the furnace zone, contains a gas passage in each wall which discharges through a common duct to the exhaust fan and communicates with the kiln interior through 28 openings placed on the level of the gas passages in the truck platforms. Between each pair of openings are brick baffles extending from the side walls, intended to prevent short-circuiting of gases between the green ware and the kiln sides. Roof baffles are placed at intervals of 10 to 12 ft. for the same purpose. Both walls and roof are heavily lagged with loose diatomaceous earth. Walls in this section range from 22 in. to 3 ft. 4 in. in thickness.

The furnace zone is the most interesting one from a structural standpoint. The lower part of each wall, which is 3 ft. 11½ in. thick, is occupied by a combustion air passage, communicating with each of the 64 burner openings. These openings are arranged 32 on a side and occupy over half the length of this zone. Burners are spaced on 31½-in. centers, each pair of burners on one side being separated into a group by the kiln bracing. The buckstays in this zone are kept closer together than elsewhere and are provided with special adjustments

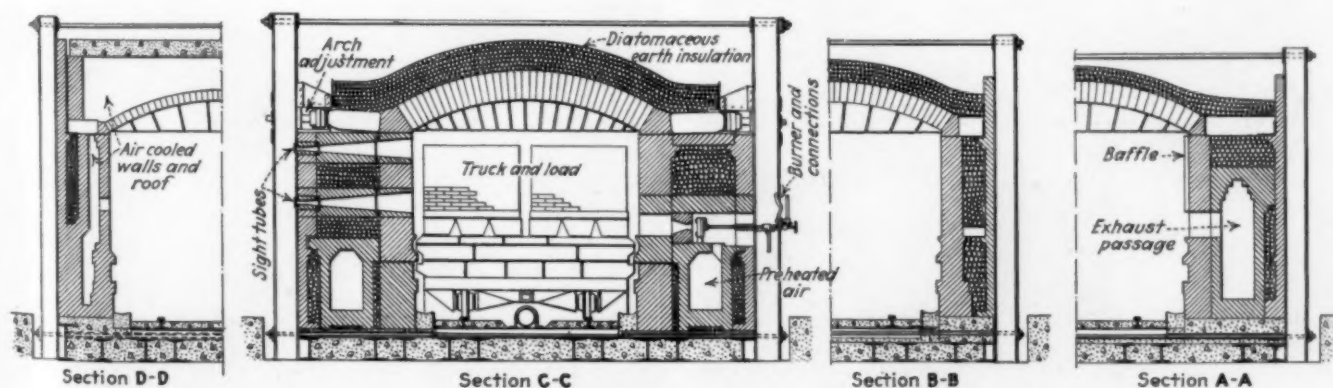


Fig. 4—Typical Sections Across the Kiln

(A-A) Preheating zone showing air ducts in walls for exhausting products of combustion. (B-B) Narrow section of preheating zone. (C-C) Furnace zone, showing at the right a burner opening, burner in place and combustion air duct. At the left are two sight holes. A loaded truck appears in the kiln. (D-D) Cooling zone showing cooling air spaces in walls and roof.

for handling expansion or shrinkage of the kiln arch. In addition to tierods, top and bottom, a heavy screw adjustment is used to regulate the pressure applied to the skewbacks which terminate the arch on either side. This arrangement insures proper curvature of the arch, regardless of temperature. As in the preheating zone, both walls and roof are heavily lagged with diatomaceous earth.

Burners are provided with 528 B.t.u. city gas by means of an 8-in. diameter by 13-in. stroke Chicago Pneumatic compressor driven by a synchronous motor through a Reeves drive. A second gas unit is provided for standby service. This arrangement will deliver gas for the burners at a pressure of 10 lb., and will handle up to 19,000 cu.ft. per hour at 300 r.p.m. The gas consumption is in the neighborhood of 12,000 cu.ft. per hour.

The burners are divided into six groups, each of which is served from a separately controlled line. Burners are a development of one of the authors (G. E. Seil; patents pending) and have given evidence of very efficient atomizing and mixing of the gas and combustion air. (To demonstrate the atomizing effect a burner, when supplied with 200 lb. steam, produced a material resembling cotton wool from molten blast furnace slag, and produced dust from molten zinc.)

The burners are an extension of the venturi principle, best explained in connection with Fig. 9. Each burner is cooled by water which circulates through the

pipes supporting the burner in the furnace. Gas supplied to the burner interior through a pipe, concentric with one of the water pipes, exits at high velocity through an annular orifice surrounding the air passage. Air is entrained by the gas and the mixture is ignited as it passes through a venturi block of refractory into the kiln. The air supply is permanently adjusted by means of a cone of refractory material which is supported behind the burner on a piece of $\frac{3}{8}$ -in. Allegheny Metal pipe. It is possible to adjust the air supply by sighting the flame through the pipe and thus determining the proper location for the cone.

After the burner is installed in the opening the latter is bricked up, and the adjustment, once made, is retained. Gas and water piping connections to each burner are made through flexible metal tubing of such length that the burner may be completely withdrawn from the kiln without breaking the unions. The gas line to each burner is provided with a flow meter for adjusting the gas flow. This consists of an orifice plate connected to a U-tube manometer containing oil. The purpose of the gas adjustment is to insure the most efficient supply to the burners. It is not used to regulate kiln temperature. The burners are either turned fully on or off.

The burners are concentrated in approximately 80 ft. of the length of the furnace zone. They extend to within about 11 ft. of the preheating and 32 ft. of the cooling zone. Large openings are provided about mid-way of the 32-ft. zone into which the preheated com-

Fig. 5—Preheating Zone Looking Toward Vestibule Showing Wall Baffles, Exhaust Openings and Sand Seal



Fig. 6—Furnace Zone During Construction Showing Burner Openings and Sight Holes

Note at the sides the adjustments for the arch skewbacks

Fig. 7—Exterior View, Furnace Zone, Showing Burner Connections and Flow Meters in Gas Lines

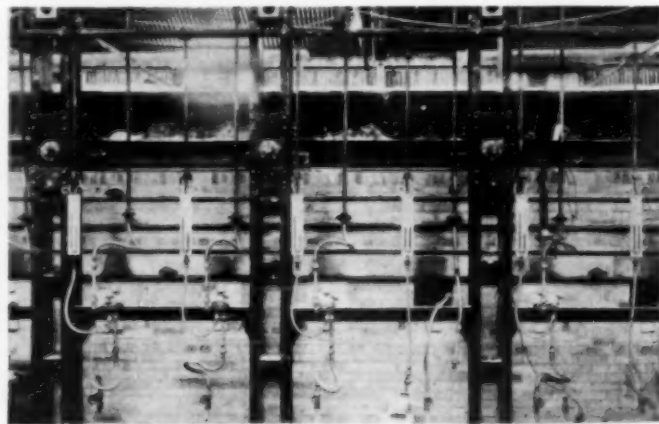


Fig. 8—Furnace Zone After Completion Looking Toward Cooling End

This view clearly shows side and roof baffles and the sand seal in the floor

bustion air passes from the cooling zone on its way to the burner air ducts. Another duct placed in a recess in the kiln floor extends each way from the boundary of the furnace and cooling zones. This is provided with jets at frequent intervals to discharge cooling air beneath the trucks. This duct extends half of the length of each zone.

The cooling zone is of two parts. That nearest the furnace portion, 55 ft. long, is of brickwork, built with cellular walls, and a large air duct over the arch. This is formed by placing a flat cover over the entire kiln in this region. Cooling air for the ware is forced into this duct by a fan and passes down through the wall cells and into the kiln interior through four groups of four openings each. This air cools the ware, after which it enters the combustion air duct. This portion of the zone is lagged only through a part of the wall height.

The second section of the cooling zone is of sheet iron and extends the final 25 ft. to the exit. No air passages are provided here, as the radiation is relied upon for further cooling.

Control of the kiln is of three sorts, making use of measurements of both kiln and ware temperature and of draft. Draft measurement, made by a number of indicating draft gages, is very important. Draft is maintained slightly positive at the cooling end and nega-

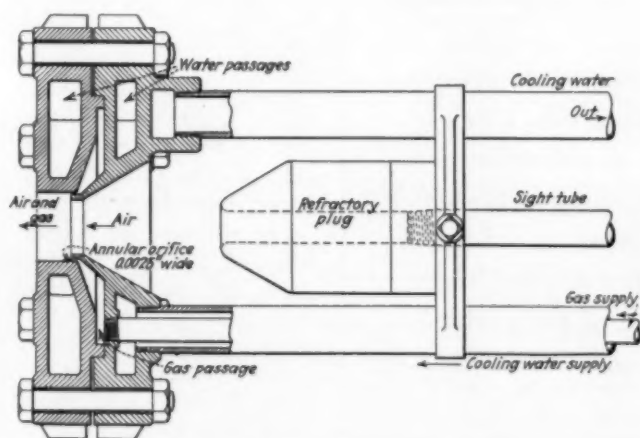


Fig. 9—Self Burner Used in the Kiln

These burners are supplied with 528 B.t.u. city gas and cooling water. Adjustment of the air supply is made by means of the movable refractory cone shown at the right.

tive in the furnace and preheating zones. The location of the zero point is of considerable value and is maintained at about the fourth pair of burners from the cooling end. The temperature control is effected in the furnace zone by means of twelve recording radiation pyrometers of Thwing manufacture which give the ware temperature. These record on three 4-record recorders. To enable the ware to be examined and for the mounting of the pyrometer tubes, sight holes are provided in the kiln walls at frequent intervals and at three different levels. Each sight hole consists of a funnel-shaped opening with the large end in. The small end is covered by a cast-iron flap when not in use. In twelve of these openings the pyrometer tubes are permanently mounted to give the actual temperature of the ware.

Kiln temperature is determined in the hot end of the preheating zone by means of six platinum thermocouples operating a single recorder. Six base-metal couples, operating another single recorder, measure the temper-



Fig. 10—Cooling Zone Showing Truck-Cooling Duct on the Floor

Cooling air, after passing over the ware, enters the large opening at the left, passing thence to the burners at a temperature of 2,000 deg. F.

atures at two points beneath the trucks, in the exit gas duct and in the cooling and early preheating zones. In addition, the maximum kiln temperature reached in the furnace zone is indicated by means of pyrometric cones placed in each car.

The trucks are 6 ft. 11½ in. wide by 5 ft. 3 in. long, and are provided with grease-lubricated roller bearings. A tongue cast in the end frame of each truck meshes with a groove in the next to obviate the possibility of a truck's becoming derailed in the kiln. Loading platforms are built of two courses of special firebrick blocks topped by a layer of high alumina slabs. On this rests a course of silica block set on edge to provide large gas passages, and above this is the platform proper, composed of silica slabs formed with small openings between adjacent slabs. The fireclay blocks are formed at the outer edges to provide the side seal and also seals with adjoining cars at either end.

It is believed that the foregoing will give some idea of the many features entering into the design of a modern tunnel kiln. Later the authors hope to describe the new equipment now contemplated for putting the processing and forming operations on a parity with the new kiln itself.

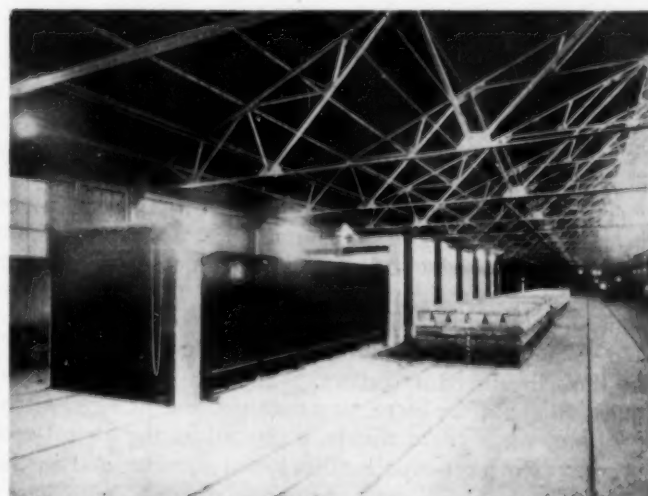


Fig. 11—Exit End of the Kiln Showing Both Iron and Air-Cooled Cooling Zones

Birmingham's Interest in the World Nitrogen Industry

By Bethune G. Klugh

Vice-President, Federal Phosphorus Company
Birmingham, Ala.

NOT LONG ago it was my privilege to inspect nitrogen fixation plants of various processes used in Germany, France, Belgium, Switzerland and Italy. Construction and production costs were obtained in a number of cases. Among the most interesting, as bearing upon conditions in the Birmingham district, were the plants in the Ruhr district in Germany and those in Belgium. Incidentally, the highest production cost item in all the processes is that of the hydrogen. Several means are in use, including electrolysis of water; water gas from coke, and the newest—from coke-oven gas. That is the source of hydrogen employed in five new plants in the Ruhr district in Germany, four plants in Belgium, one in Holland and ten in France.

The interesting fact is that all the Ruhr plants are independent of and in competition with the great I.G.'s enormous plants in their own country, in spite of the fact that the Haber plants were producing 2,000 tons of nitrogen per day and had been established several years prior to the starting of these Ruhr plants. This is prima facie evidence that under certain conditions the coke-oven gas method is the cheapest of all. This is further substantiated by cost statements.

My studies of the coke-oven gas ammonia plants were intensified by the knowledge that very similar conditions exist in the Birmingham district. Using procedure identical with that in the Ruhr district, there is a potential capacity of coke-oven gas in the immediate Birmingham district for producing 1,000 tons of fixed nitrogen per day, or 350,000 tons per year, without disturbing the balance of the existing coke-oven gas service. Only 30 per cent of the heat value of the original gas is consumed in the nitrogen fixation, while the rest is turned back at a much higher heat value per cubic foot than the original.

The 1,000-tons daily production of fixed nitrogen proposed for the Birmingham district would be about one-half the production of the I.G. in its two German plants today, or about 15 per cent of the world's consumption projected for 1930. Such an operation would add \$25,000,000 per year to the value of the coal coked in the Birmingham district. There appears to be no question about the increasing consumption of fixed nitrogen, and while there will be competition, the lowest-cost producers in economic locations will survive, and in the present state of the art the lowest potential cost factors appear to exist in the Birmingham district.

In the European nitrogen industry most interest lies

in the production, marketing and use of concentrated fertilizer. The lead has been taken by the Nitrogen Syndicate and the I.G. in the program it is vigorously extending even into the United States. It has placed on the market during the past three years fifteen entirely new concentrated, soluble fertilizers to meet the requirements of various soil and plant conditions. It has established extensive experiment stations to determine definitely the actual effect of its products on all character of plants in all classes of soils. It has invaded American agricultural chemical markets and captured business now aggregating about \$10,000,000 per year, and has a prodigious extension program for greater increase.

Another word as to the activities of the I.G. in American agricultural chemical industry: The corporation is today taking phosphate rock from Florida; shipping it across the Atlantic to Hamburg, hauling it 150 miles by rail to Piesteritz. Alongside this location it is mining in open cut by electric shovel lignite coal of about one-third the heat value per pound of our Birmingham steam coal, with which it generates steam electric power. It then smelts the phosphate rock by means of this electric power, producing phosphorus, from which is produced concentrated phosphoric acid. Meanwhile, a few miles from Piesteritz, at Leuna, the I.G. takes Ruhr coke, which has been hauled 225 miles and which is very similar to our Birmingham coke, and

uses this to produce hydrogen through water gas. The labor rate is little below that in Birmingham. This ammonia is then combined with the phosphoric acid of Piesteritz to produce ammonium phosphate and other related compounds, a large tonnage of which is shipped through Hamburg, back across the Atlantic, and sold at a profit in the Birmingham district and other points over the United States, as concentrated fertilizers.

We naturally wonder: How do they do it? To an important extent the answer comes from contact with industrial Germany today. They are working—from the highest official to the laborer. There is a co-operative confidence between capitalist and technologist. Every industrial operation is directed in every division by technical men with detailed knowledge of that industry. Research development and investigation are practiced on an adequate scale by competent technicians under able direction, with eternal vigilance for cutting production costs, improving processes and products, as well as initiating new products. A technical consciousness seems to pervade the atmosphere. A sense of duty to perform every detail completely and efficiently is almost universal. Non-productive and leisurely pursuits are always secondary to business. With these principles and characteristics incorporated into our industrial life, we will be on a par with them.

The I.G. has an appreciation of the relationship of its industry to agriculture, and directs its technical and sales policies accordingly. In this it has set a standard that competitive institutions must adopt and maintain to survive.

Birmingham, with a potential capacity for producing a thousand tons a day of synthetic ammonia from coke-oven gas, has a real interest in nitrogen fixation. In this brief excerpt from an informal talk before a local group, Mr. Klugh gives us a clear picture of the possibilities for carrying out such a development.

High Purity Magnesium Produced by Sublimation

By H. E. Bakken

American Magnesium Corporation
Pittsburgh, Pa.

A METAL purity of 99.99 per cent is rather unusual in the commercial production of most metals. However, for many industrial uses, magnesium of high purity is very desirable and for certain purposes such a high purity is essential.

Magnesium may be commercially produced by electrolysis of fused magnesium chloride. This salt of high purity can be obtained from certain salt deposits. Magnesium may be commercially produced also by electrolysis of calcined magnesite in a fused electrolyte of fluorides. The purity of the metal produced by these processes depends primarily upon the purity of the raw materials employed; but under certain conditions it may not be feasible or even desirable to employ pure raw materials. For this reason a process has been developed to purify metal made from a relatively impure and therefore cheaper ore. It may be mentioned that such a process of purification is of value also in the recovery of scrap metal.

Magnesium has a relatively high vapor pressure and this property suggested purification by distillation. According to the estimated values of Johnston (*Ind. Eng. Chem.* v. 9, p. 873, 1917), shown in Fig. 1, magnesium has a vapor pressure of 100 mm. at 920 deg. C. At 860 deg. C. the vapor pressure is 50 mm. of mercury, while at 620 deg. C. the vapor pressure is 1 mm. Therefore, if magnesium be heated to a temperature above its melting point, 651 deg. C., in a closed container, under reduced pressure, distillation of the metal will occur. If a suitable arrangement of retort and condenser be provided the metal vapor will condense to a liquid of high purity.

In the operation of the distillation process (U. S. Patent No. 1,594,345, Aug. 3, 1926) it was found that crude or impure metal having a total magnesium content of 90 to 95 per cent could be converted into a product with a purity of 99.99 per cent magnesium. An operating procedure was worked out to permit of continuous operation by charging metal into the retort at intervals through a vacuum lock arrangement, and similarly at intervals tapping off the condensed molten liquid into molds contained within a vacuum chamber. In this manner the purified metal could be produced in ingot form without oxidation or the formation of air reaction products.

Because of the fact that the entire system of charging arrangement, retort, condenser, and tapping chamber had to be operated under a continuous low residual pressure and, moreover, that a portion of the system had to be heated to temperatures of 651 to 800 deg. C., a very special mechanical development was necessary. For ex-

ample, considerable experimental effort was put forth to produce welds which, under the prevailing conditions of temperature change, would not leak through cracks and pores. It was finally proved that satisfactory welds could be consistently obtained by the use of a short or close electric arc and by making a weld of successive layers with vigorous peening of each layer of deposited metal prior to the application of the following layer. In the welding of $\frac{3}{4}$ -in. to 1-in. stock, a weld by this procedure would be made up of three to five successive layers of deposited metal. Many problems also were necessarily encountered in arriving at a practical control of the low-pressure conditions essential for consistent operation.

Since a low distilling temperature depended upon maintaining the lowest practicable residual pressure within the system, effort was put forth to obtain such a pressure. As experience was gained the daily average of residual pressures became steadily lower, until at times, because of the lowered pressure, metal was vaporized in the retort at temperatures very near the melting point of magnesium. Occasionally the condenser temperature was actually above that of the retort. Such a result necessarily made the equipment inoperative, for by design the condenser was fitted with a heating arrangement to maintain a condenser temperature slightly above 651 deg. C., or the metal's melting point, so that in normal operation the condensed metal could be drawn off and cast into molds. When such conditions arose the residual pressure of the system was increased by admitting outside air through a bleeder valve.

By continued experimentation it was found that

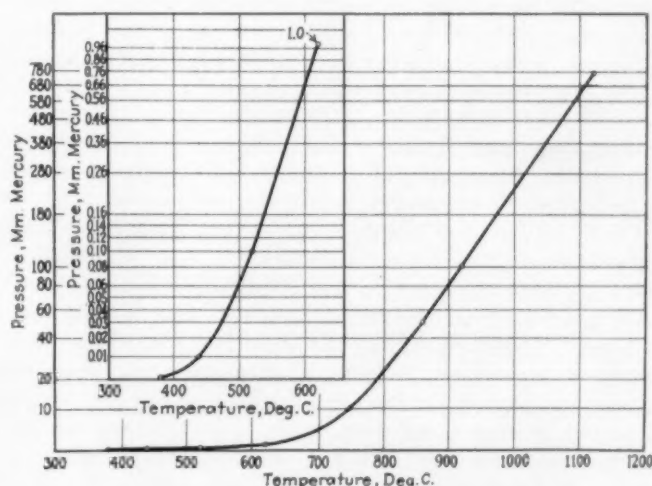


Fig. 1—Vapor Pressure of Magnesium

residual pressures of less than 2 mm. could be obtained and these observations led to speculation with regard to substituting a sublimation process (U. S. Patent No. 1,594,344, Aug. 3, 1926) for a distillation process. Grave doubts were expressed as to whether or not the rate of vapor flow in a sublimation process would be sufficiently

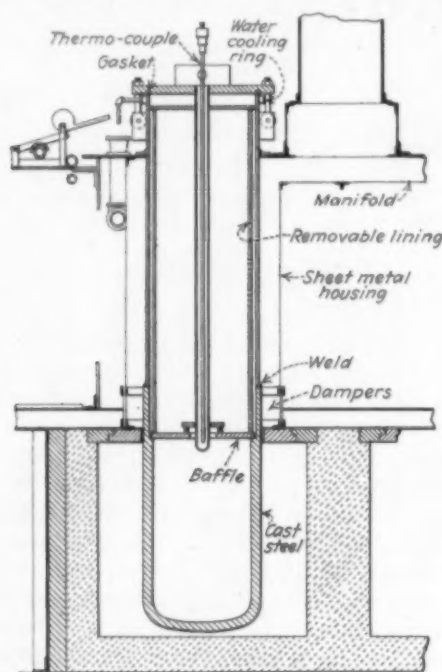


Fig. 2—Longitudinal Cross-Section of Sublimation Retort

rapid to be commercial, and also whether or not equipment could be built to operate practically under a lower residual pressure than 2 mm. at such temperatures. Preliminary experiments pointed to favorable expectations, for it was found that by reducing the pressure to approximately 0.5 mm. rapid sublimation could be accomplished—i.e., magnesium vapor formed directly from metal in the solid state.

Purification by distillation had proved quite expensive because of the rather rapid deterioration of iron equipment at the temperatures of operation. On the other hand, by operating under still lower pressure, at temperatures below the melting point of magnesium, it was considered that the temperatures of operation would be well within the range where ordinary iron or steel equipment might function very satisfactorily. It was thought that at these relatively low temperatures the difficulties of constructing equipment which would withstand continued external pressure would be greatly reduced, as compared with those experienced when the operation of distillation is carried out under reduced pressure, but at a considerably higher temperature. The immediate practical gain was to be found in the possibility of employing larger diameter units in carrying out the operation.

Fig. 2 is a longitudinal cross-section of a single unit in a battery of sublimation retorts. Supported vertically in a suitable structure is the metal retort comprising a cast-steel boot welded to a thinner wrought-iron condenser. The open end of the retort may be closed by a quick-acting cover. A gasket is employed between the cover and retort. It has been found necessary to water-cool the joint in order to maintain a satisfactory vacuum within the unit. Within the condensing end of the retort a closely fitting, removable lining is provided upon which the condensed metal deposits. The lining is split longi-

tudinally in order to facilitate removal of the deposited magnesium.

In operation each retort is charged with metal to be refined, placed in a furnace, and connected to a vacuum line. The retort for approximately one-third of its length is heated in any suitable manner, preferably by a well-distributed gas flame. The upper part of the retort, which serves as a condenser, is surrounded by a sheet-metal housing, having dampers at its lower end and connected at its upper end to a manifold. Control of the condenser temperature is obtained by the amount of damper opening. The temperature of rapid sublimation may vary from approximately 300 deg. C. at 0.001 mm. pressure to 651 deg. C. at 2 mm. pressure. Experience has shown that successful operation consists in heating the charge to a temperature of approximately 600 deg. C. for a period of from 5 to 6 hours under an absolute residual pressure within the condenser of approximately 0.5 to 0.15 mm. of mercury. Under these conditions the evolution of vapor will be rapid. If proper condensation facilities are provided the rate of sublimation within limits will depend upon the quantity of heat applied to the metal in the retort.

It is essential that the temperature in the condensing area be below that of the metal being sublimed, since the difference in vapor pressure resulting from this difference in temperature is the driving force which causes the rapid transfer of magnesium vapor from the subliming to the condensing end of the system. As indicated above, in order that the temperature at the condensing end of the retort may be varied, dampers are provided to control the quantity of cold air passing around the outside of the condenser. Very satisfactory temperature control may be accomplished in this manner.

Under the conditions outlined, magnesium does not melt but passes directly from the solid to the vapor state. The vapor rises to a cooler position, where it condenses on the lining in the form of coarsely crystalline

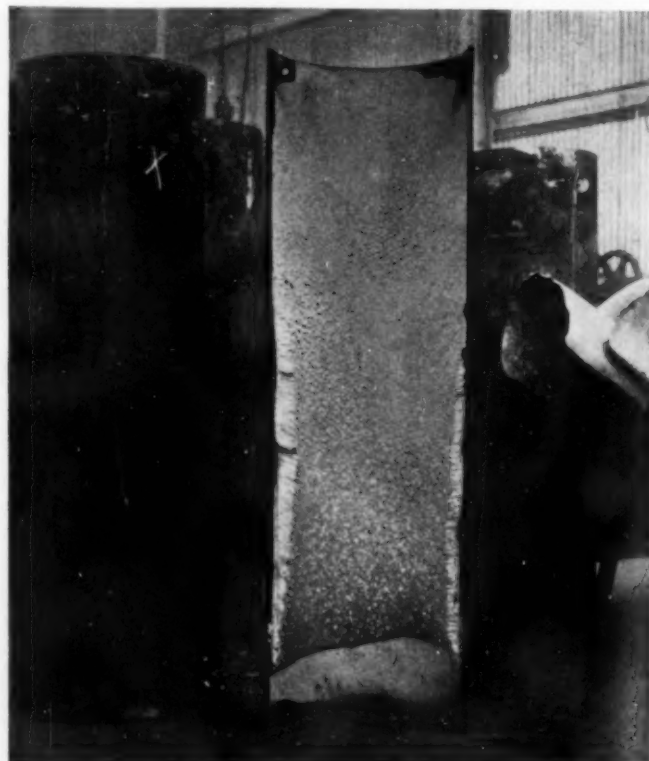


Fig. 3—Sublimed Metal Deposit in Removable Lining of Retort

aggregate illustrated in Fig. 3. When the charge of metal has been sublimed (which can be determined by tabulating the average temperature, amount of charge, and time, or perhaps more simply by noting a sharp temperature drop in the condenser), the retort unit, after having been sealed under a vacuum by a suitable valve arrangement, is removed from the furnace and allowed to cool. The retort is then opened, the condensate and residue removed, and the retort is recharged. In operation a group of units is carried through the cycle—i.e., while one group is being cooled a second group is being charged and a third group is being heated.

During sublimation the materials of the charge having

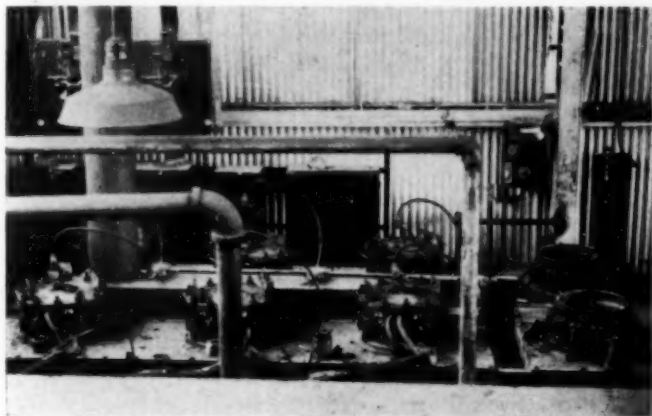


Fig. 4—Upper Sections of Battery of Sublimation Units

a higher boiling point, such as iron, aluminum, and silicon, remain behind as a residue. Very often, however, impure magnesium may contain metals which are volatile under the conditions of operation. In actual practice it has been found possible to effect a separation of volatile metals. If sodium-containing metal, for example, be refined, the more volatile sodium will, during the process, rise to a cooler position in the condenser than will magnesium vapor. Under suitable conditions of temperature control a deposit of sodium somewhat contaminated with magnesium will be found separated from the main body of deposited magnesium. In general it can be said that the degree of separation will depend upon the difference in boiling points of the metals under consideration.

Analysis—Magnesium purified by sublimation is substantially free from metallic impurities, as illustrated by the following analysis: Silicon, 0.003 per cent; iron and aluminum, 0.007 per cent; magnesium by difference, 99.99 per cent. The purity shown compares very favorably with the purest obtainable zinc, tin, copper, aluminum, and iron. Because of the absence of reactive gases during the process, the deposited mass is free of admixed oxides or nitrides. In addition, magnesium so purified is free from non-reactive but soluble gases, as, for example, hydrogen.

Density—Magnesium is the lightest of all known metals that are stable under atmospheric conditions and which at the same time have mechanical properties that permit of uses for structural purposes. In comparison with two well-known metals, aluminum and iron, magnesium volume for volume is approximately one-third lighter than aluminum and approximately four-fifths lighter than iron. The density of sublimed magnesium of 99.99 per cent purity and metal of somewhat lower

purities (99.5 per cent and 99 per cent, respectively) has been determined by Edwards and Taylor (*Trans. Am. Inst. Min. Met. Eng.*, v. 69, p. 1070, 1923) in the research bureau of the Aluminum Company of America:

Density of Magnesium		
Purity of Test Pieces Per Cent Magnesium	Density at 20 Deg. C. Grams / cc	Form
99.99	1.7388	As extruded 1-in. diameter
99.99	1.7388	Same, annealed 2½ hr. at 400 deg. C.
99.95	1.7381	As extruded
99.90	1.7381	As extruded

Density of Magnesium at and Above Its Melting Point		
Temperature, Deg. C.	Density Grams / cc	Remarks
650	1.642	At melting point, solid (calculated)
650	1.572	At melting point, liquid (extrapolated)
673	1.562	Measured
700	1.544	Interpolated

Electrical Conductivity—Purified magnesium has a volume conductivity of 38.65 per cent of that of copper. The mass conductivity of magnesium is 197.7 per cent of that of copper. The specific resistivity of sublimed magnesium 99.99 per cent pure also has been measured by Edwards and Taylor. The results are tabulated below:

Volume Basis

Volume resistivity (microhms per cm² at 20 deg. C.)... 4.4611
Volume conductivity (per cent of copper standard)..... 38.65

Mass Basis

Mass resistivity (ohms per meter per gram) 0.007753
Mass conductivity (per cent of copper standard)..... 197.71

Linear Expansion—The thermal expansion of sublimed magnesium has been determined by Peter Hidnert and W. T. Sweeney (*Bureau of Standards Journal of Research*, Vol. 1, page 77, November, 1928). Their results are shown in the tabulated equations which hold for a temperature range of room temperature to 500 deg. C.

Cast Magnesium (specimen cast in vacuum furnace at 665 deg. C.)
 $L_t = L_o [1 + (24.94t + 0.00946t^2) \cdot 10^{-6}]$

Extruded Rod (specimen extruded at temperature 410 deg. C.)
 $L_t = L_o [1 + (24.66t + 0.00976t^2) \cdot 10^{-6}]$

Average of above equations
 $L_t = L_o [1 + (24.80t + 0.00961t^2) \cdot 10^{-6}]$

Corrosion—The subject of the corrosion of magnesium has received considerable attention. Probably the most comprehensive published treatise on the subject of corrosion of magnesium and magnesium alloys is the work of Boyer (Report 248, National Advisory Committee for Aeronautics, 1926). It is generally accepted that the mechanism of metal corrosion in salt solutions involves electrolytic action, modified by film formation. Metals having relatively lower solution potentials than magnesium in general do not corrode as rapidly. In moist air the surface takes on a grayish white coating which probably is hydroxide with admixed oxide and carbonate. In a dry atmosphere magnesium will retain its white silver-like luster indefinitely.

ERRATUM—Through an unfortunate transposition of type the business connections of the two authors of the article "Will It Pay to Process Coal for Generating Power," in the May issue, were incorrectly given. Mr. McMichael is a consulting engineer and Mr. Knapp is connected with E. L. Phillips Company.

How Chemical Engineering

By George E. Walker

President, Albany Air Service,
Albany, N. Y.



MATERIALS of maximum strength and durability with minimum weight—surely, chemical engineering service is indicated here. Maximum strength: steel alloys; maximum durability: protective

treatment and coatings. But minimum weight: this presents the problem. Humanity has determined to transport itself from place to place through the invisible medium of the air, producing the necessary buoyancy by either static or dynamic means. In the former method a large volume of a gas lighter than air is utilized, the traveler throwing in himself and baggage to equalize the difference in specific gravity. Utilizing dynamic means, on the other hand, the air itself is put into a motion of hurricane proportions and the would-be traveler literally rides on the tail of the atmospheric disturbance created. Both methods—each with its bevy of proponents, known as the lighter-than-air and the heavier-than-air groups—are utilized today. Both require that the chemical engineer and metallurgist provide materials for man-made wings that are stronger, yet ever lighter.

Within the scope of this article only a few of the needs may be touched on, and but a few of the problems unsolved may be pointed out. For the actual acquirement of wings has merely opened the way to other studies of aeronautics and utilization. Thus the chemical engineer is called on in such problems as dispelling fog above an airport area, or as to what he can suggest as coating to minimize the formation of ice on wings and propellers. Again, what can he do to make crop-dusting insecticides lighter in weight, yet more effective and suitable for distribution above plantations and orchards from the air?

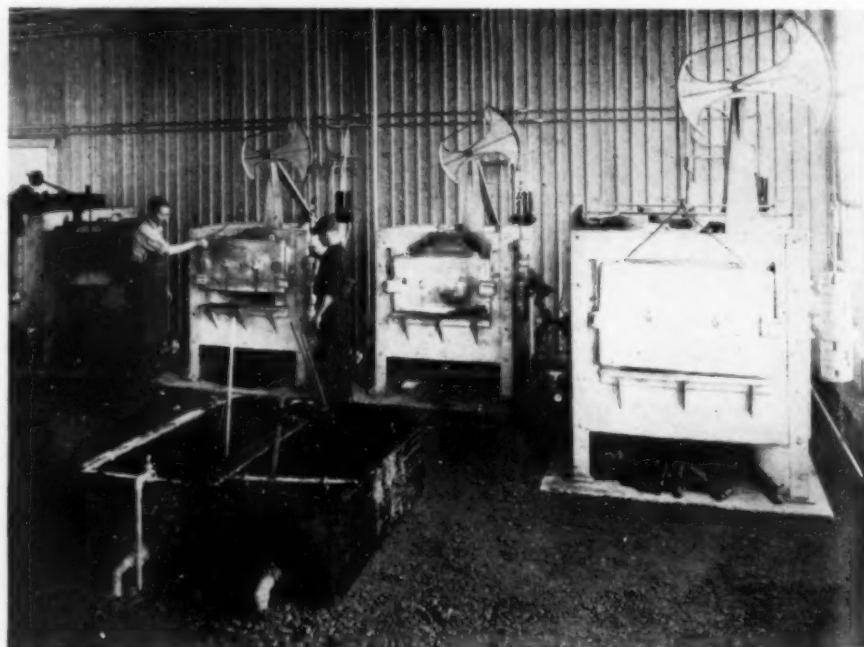
But of primary interest is the question, Which shall be used for lift and stream-line surfaces of airplanes and dirigibles: fabric or metal? The Wrights used untreated muslin for their first flights. Later shellac and other lacquers were used, not only to increase durability but to toughen, strengthen and smooth the fabric. Just before the War, nitrocellulose and, later, cellulose acetate "dopes" were introduced for this purpose. Mercerized cotton, sewn loosely over the wing sections and fuselage, could then be shrunk drum-tight with application of "dope." The strength of the fabric was thus increased nearly a half over that of the untreated fabric. The safe life of the surface was lengthened to more than a year with proper usage,

and the skin friction, or parasitic resistance, was very materially reduced.

Acetate "dopes" are desirable for their slighter flammability, but dirigible builders still prefer nitrate cellulose for first coatings, because it seems to penetrate the fibers of the fabric more satisfactorily with less addition of weight. In fact, among the airplane manufacturers, especially for more important fabric-covered surfaces, such as wings and control areas, the first four coatings are specified as nitrate "dope." Acetate "dope" is then applied for successive exterior coatings. Can we improve the so-called "dope" or create substitutes which are better? Can they be made non-flammable? Can they be made to penetrate and toughen the fibers properly, using less weight per square yard? Can a non-flammable, durable surfacing material be devised which could be shipped in rolls (as paper) or bolts (as cloth) in a partly cured condition such that after tacking, or otherwise applying this material to airplane skeleton structure, curing could be completed with proper toughening and hardening?

Although in this country the greater proportion of airplanes and dirigibles is covered with "doped" fabric, there is one all-metal, experimental dirigible now under construction, utilizing thin sheet metal, of an alloy known as Alcad, produced by the Aluminum Company of America. However, the outstanding instance of success in the use of metal surfacing is the Stout Allmetal Airplane, now commonly known as the Ford Trimotor, since its production has been financed and sponsored by the Ford company. It must be understood that covering with

Structural Metallic Members Are Heat Treated in These Furnaces



g *Has Improved Aircraft*



corrugated sheet metal permits utilization of the sheet itself to enhance the structural strength of a member, thus dispensing with some of the internal trussing needed in the case of the fabric-covered structure, wherein the fabric gives no strength of itself.

But here again are presented problems for unlimited chemical and metallurgical experiment. During the War a Zeppelin was brought down by anti-aircraft fire just outside of London; examination of the wreckage disclosed a metal of steel-like strength but aluminum lightness. Analysis disclosed the alloy components. It seemed then but a small problem to combine these specific metals, as found by analysis, and obtain the same finished metal product. But the British Government Laboratories failed time and again until the proper method of cooling and tempering was discovered, partly by accident. The Allies were then possessed of the knowledge required for production of the alloy known as duralumin, which the Germans had been manufacturing for some time previous. This alloy, which is now generally adopted for aircraft, has the strength of mild steel but less than half of its specific weight.

The writer believes that all-metal construction will ultimately replace "doped" muslin and wood, as these are temporary makeshifts, awaiting the further development of strong, light metals. Considerable research is now under way on magnesium alloys, but it is yet too soon to predict ultimate success. Mr. Stout, of the Ford-Stout company, doubtless the leading authority on the subject of metal construction in this country, before a gathering of leaders in aviation research and development, pointed out that alloys of beryllium give great promise, but he went on to state that at present very little is known even of the method of economical extraction of this element from its ores. Surely, there seems to be opportunity here.

Present-day methods of treating structural material are reproduced in the accompanying cuts, which are here available through the courtesy of the Fairchild Aviation Corporation, Farmingdale, Long Island.

Other structural parts, usually made of wood, also are feeling the inroads of the chemical engineer—armed this time with the synthetic resins. The use of these products holds promise not only for partly decorative applications,

as paneling and instrument boards, but also for the severe trials involved in pulleys and propellers. Laminated propellers of excellent workmanship have been produced out of Micarta, the new Westinghouse resin, and are now undergoing a probationary period in service.

The development of aircraft motors has merely begun. No one dares predict what will be their ultimate form, mechanism or component material. The radial engine, which seems to find favor at the present time, is but a suggestion of how far design and material may vary from that of the automobile engine. The airplane motor is, at best, a series of compromises between light weight and structural strength. Dispensing with large factors of safety must be deliberately contemplated from the point of view of all-around efficiency. A safety factor of one is the ideal, but at present no one dares trust that alloys will possess the necessary uniformity of ability to stand up under rapidly repeated distinctive strains and stresses. Five years ago it would have been difficult to believe it possible to harness 200 to 800 hp. in a series of cylinders having walls $\frac{1}{8}$ in. in thickness, as is being done at present. But lighter, stronger metals will be evolved; their uniformity can be assured by automatic control methods and X-ray analysis. In 1903 the engine



Applying the "Dope," the Properties of Which Finally Govern Wing Dependability

used by the Wright brothers, the lightest per horsepower until then ever used, weighed 12 lb. per horsepower. Today we are building engines of 600, 200, 100 and 50 hp., weighing $1\frac{1}{2}$, 2, 3 and $3\frac{1}{2}$ lb., respectively, per horsepower.

The many considerations of modern engine design can not be given here, but each points an elementary problem for the chemical and metallurgical professions to solve. For example, in a large bore, long-stroke, high-compression cylinder, tremendous heat must be quickly dissipated to avoid melting or burning valve seats and heads. Silichrome and chrome-nickel-tungsten steels are now being utilized in this connection.

Satisfactory fuels, of course, are an almost exclusive chemical engineering problem. Although *terra firma*

motordom has demanded, and hence caused, a highly developed petroleum industry, its needs often fall short of and disagree with those of aviation. The most conspicuous difference here, of course, is the imperative call for space and weight conservation in aircraft; research accordingly seeks a fuel with greater power per unit of weight or space.

Lubrication of aviation engines may be roughly compared to that of any combustion engine, but more specifically such is not the case. In our automobiles we utilize a certain oil for summer, and one of somewhat different characteristics for winter. In the air, operating conditions of all four seasons may be experienced within the range of ten thousand feet of altitude, a matter of a half hour going up, and perhaps ten minutes coming down—that is, coming down discreetly. We need lubricants to stand up under such suddenly variable working conditions.

When the fledgling pilot finds himself for the first time in the midst of enveloping fog, his sensation is one of being forever lost. He may as well close his eyes as far as anything outside the plane is concerned, and the rest of his senses seem to go on a sympathetic strike, not excluding those of hearing, smell and taste. His mind stops working, he is truly befogged and is convinced that his relation to the universe has been permanently severed. I can imagine no nightmare to compare with it. The instrument board is the only saving element, and the devices at present furnished will take care of him, so long as he can keep off the earth, so to speak.

Immediately upon its becoming necessary to land, however, the pilot is in trouble. If there is clear atmosphere somewhere between him and the ground a safe landing is reasonably possible. If the fog reaches right on down, he will crash. We now speak of aviation's greatest problem—fog. Professor Bancroft, in his "Colloid Chemistry," points out the possibility of precipitating rain by coagulating clouds into rain drops about the nucleus of electrically charged dust particles. Could the cloying blanket which so frequently clings to an airport landing area, especially near the seacoast, be similarly clarified?

Ice formation is another enemy of aviation lurking in the atmosphere to destroy the modern Icarus. It is admitted that perhaps many who lost their lives in transoceanic attempts were vanquished by this fearsome dragon. It is not so much the weight of the ice that occasions disaster as the deformation of the efficient wing curve at the leading edge of the wing. A very small encrustation on the entering portion of the wing so changes the shape that the lift and balance of the plane are destroyed, allowing the ship to fall out of control. Or again, ice may form evenly over the surface of the

propeller. Vibration will throw it off one blade, but perhaps it will remain attached for a time to the other. The high-speed unbalanced rotation resulting then creates sufficient stress to destroy the engine almost instantly.

When the German Junkers plane "Bremen" crossed the Atlantic from east to west, the only plane which has ever accomplished this task in non-stop flight, the experiment was attempted of utilizing a coating of paraffine upon wing and control surfaces and propeller blades. The plane reached Labrador without ice formation. Although the pilots claimed that instruments which they carried for determining relative humidity and temperature indicated that the plane was for long intervals of flight in strata of atmosphere provocative of ice formation, none formed.

Whether or not paraffin coating is of any benefit, nevertheless, is still a question of dispute, inasmuch as the United States Army Air Force has carried out experiments which indicate that ice will continue to form

over previously paraffined surfaces in flight, and recommends that artificial heating of the interior of the wing become the expedient to counteract this danger. However, I feel the physical chemist has a problem here which, solved successfully, would be of tremendous importance to aviation. Without any doubt, essential surfaces can be so coated as to lessen the tendency for ice formation or at least decrease the adhesion of an ice film when formed.

At the time that Mr. Levine's ship was getting ready for its contemplated flight to Rome, it was decided to utilize a coating of paraffin, and Mr. Levine decided to be most thorough in the matter. He had the liquid paraffin applied quite thick, and not only coated wing surface and propeller but gave the ship a good, generous bath in the substance. The morning of the take-off for

Rome, the sun was fairly hot and conditions rather windy about the field, with the result that dust, cinders, gravel and what-not were soon gathered on the surface of the plane, and pilots who witnessed it asserted that it looked a good deal like a giant wad of chewing gum which had been rolled in the sand. At any rate, when the take-off was made, the ship could not get up sufficient speed to maintain its load in the air, gasoline had to be dumped, and a very dangerous forced landing made.

During the year 1928 the entire civilized world commemorated the first power flight of man in a heavier-than-air structure—that of the Wright brothers at Kitty Hawk, N. C., Dec. 17, 1903. Their airplane was composed, for the most part, of steel motor, bamboo, piano wire and untreated muslin. The materials and manner of utilizing them, for all their improvement and development during the intervening years, now permit of even greater progress for the immediate future.



Sandblasting a Welded Fuselage

Eliminating Health Hazards in Chromium Plating

By *J. J. Bloomfield*

*Assistant Physical Chemist
U. S. Public Health Service*

and

William Blum

*Chemist
U. S. Bureau of Standards*

BECAUSE of the growth of chromium plating in certain industries, many inquiries have been addressed to the United States Bureau of Standards and the United States Public Health Service concerning the possible health hazards involved in this process and the preventive measures to be followed in eliminating them. For this reason it was decided to conduct a preliminary investigation in order to ascertain the extent of the hazards involved in chromium plating and the steps which have been or might be taken to alleviate conditions. If future conditions should justify it, a more exhaustive investigation of the subject may be undertaken subsequently.

Even though this survey was not extensive, the results obtained in different plants were so consistent, and agreed so well with previously recorded experiences upon the effects of chromic acid and chromates, that the following conclusions and recommendations appear warranted:

1. Natural ventilation is seldom, if ever, adequate to remove the chromic-acid spray produced during chromium plating.

2. Vertical ventilation, such as is commonly used in chemical hoods, is ineffective because it draws the

chromic-acid spray past the face of the operator who is working over the tanks.

3. It is feasible by a properly designed system of transverse ventilation, with an adequate air velocity, to reduce the content of chromic acid to less than 1 milligram in 10 cubic meters of air.

4. Continuous daily exposure to concentrations of chromic acid greater than 1 milligram in 10 cubic meters is likely to cause definite injury to the nasal tissues of the operators.

5. The most efficient method of ventilation is to draw the air laterally across the top of the plating tanks into ducts from 1 to 2 in. wide and extending fully along one or more sides of the tank.

6. To be effective, the duct should not be required to draw the air a lateral distance of more than 18 in. For wider tanks there should be ducts on both sides, or else two ducts in the center.

7. The level of the plating solution should be at least 8 in. below the top of the tank and the duct should be at the top of the tank.

8. For effective ventilation it is necessary to have an air velocity at the duct of about 2,000 ft. per minute.

9. Care should be taken to avoid obstacles to the air current, such as large projecting anodes or racks.

10. A hood surrounding one or more sides of the tank may be advantageous in protecting against disturbance by other air currents, such as those from open windows or from other fans.

11. The air velocity in the duct can be measured by means of a kata thermometer.

12. A vane anemometer is usually too large to measure the air velocity in the duct. It may, however, be used to measure the air velocity at the outlet of the exhaust flue, from which measurement the volume of air and hence its velocity in the duct may be computed.

13. The air may be sampled as rapidly as 35 liters per minute by means of an exhaust and an impinger bottle containing normal sodium hydroxide solution.

14. The amount of chromic acid absorbed from the air can be determined by titration with iodide and thio-sulphate, or, if present in minute amounts, by a colorimetric test with hematoxylin.

15. The operators should guard against injury to the nasal tissues by applying to them, several times daily, vaseline or mentholatum salve.

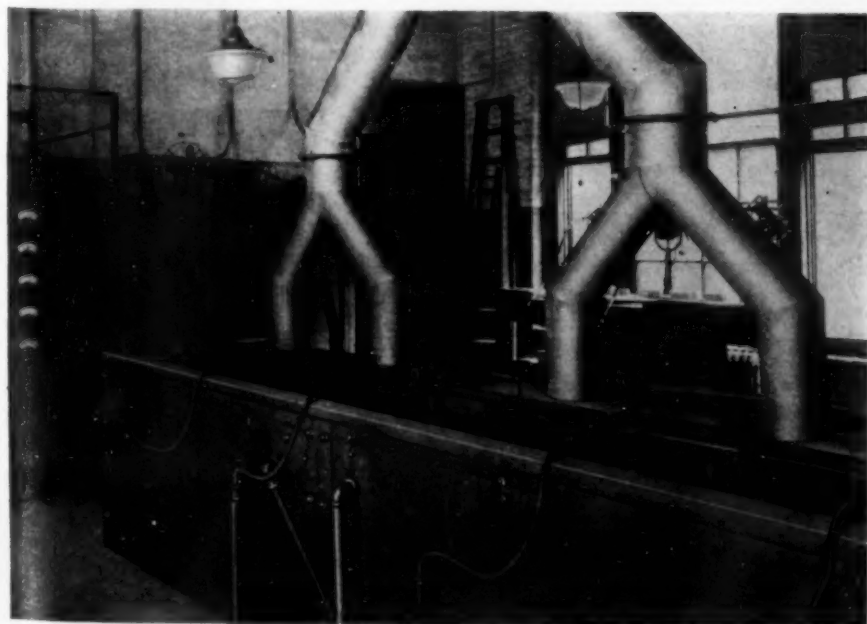
16. Rubber boots, gloves and aprons should be used when feasible, to prevent contact of chromic acid with any abraded skin.

17. If gloves are not used, the hands should be washed frequently with water, and all cuts or abrasions greased with a mixture of three parts vaseline and one part lanolin.

18. All floors near the plating tanks should be frequently washed down.

19. Operators should have periodic medical examinations, with prompt treatment of the slightest skin or nose affections.

20. Such treatment should include washing with bisulphite, ammonium polysulphide, or thiosulphate solution, application of an ointment, and a waterproof covering.



Ventilating System for Chromium Plating Consisting of Four Flues Connecting With a Horizontal Chamber Having a Narrow Slot Along the Upper Edge of the Plating Tank



Chemical Plants Are Turning to Welded Construction

Welded
Storage
Tanks,
10 Feet in
Diameter

By Alan G. Wikoff

Linde Air Products Company, New York

WELDED CONSTRUCTION is being used to an ever increasing extent in the chemical engineering industries. The reason is evident from a consideration of the operating conditions encountered. In no other field are the materials of construction subjected to such severe service conditions. They must resist the effect of acids, alkalies, corrosive salts and mixtures, as well as gases and solid materials of all types. Liquid air and the electric furnace represent the extremes of temperature to which equipment may be subjected. The pressures under which processing must be carried out also vary widely. In some cases the apparatus must maintain a vacuum of only a few millimeters while other equipment will be required to resist pressures of

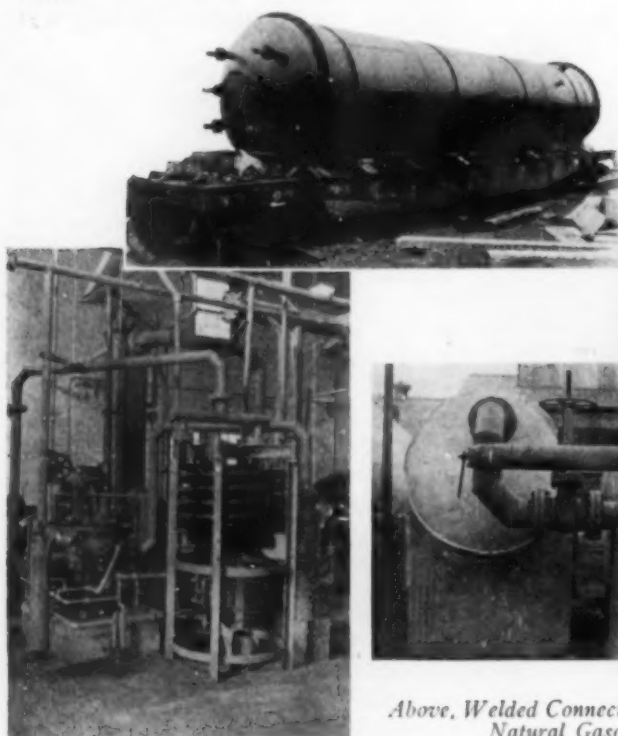
several hundred pounds or even higher. In some processes the effects of corrosion, high temperature and high pressure occur simultaneously and present an extremely difficult problem for the designers of equipment.

Practically all of the commoner metals and alloys are found in use at one point or another in the chemical industries. As these fail to satisfy all the requirements, continual investigation is being made to develop new alloys having superior properties, particularly with regard to resistance to corrosion and high temperatures.

It should be remembered that the materials handled in the process industries are all relatively valuable. This means that even a slight leak may quickly result in a considerable loss. In addition many of the materials are of such nature that leakage is most undesirable, quite aside from the question of loss involved. This is the

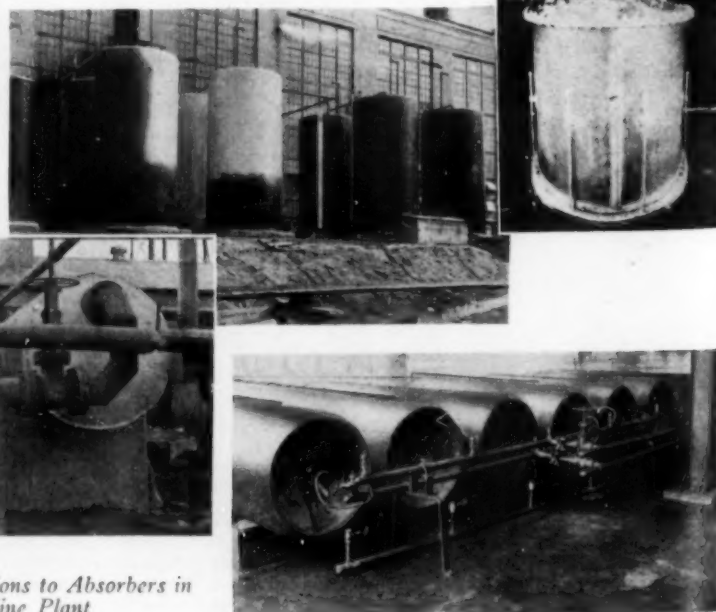
From a paper presented at the annual meeting of the American Welding Society, New York, April 26, 1929.

Lower Left, Welded Compressor Piping of Intricate Design
Below, Welded Absorber, 8x40 Ft.



Lower Right, Welded Headers for Liquid Chlorine Discharge
Below, Welded Low-Pressure Storage Tanks

At Right, Welded Aluminum Reaction Tank



Above, Welded Connections to Absorbers in
Natural Gasoline Plant

case with such materials as flammable gases and liquids and materials that are of a poisonous or physiologically injurious character.

From this brief consideration of operating conditions it is evident that the chemical industries have urgent need for a method of construction that will give a joint permanently tight and leakproof under all operating conditions and one that can be used satisfactorily with all metals, including the newer special alloys. Welding of one kind or another affords such a method of construction and is consequently being used to an increasing extent.

The various ways in which a chemical plant can utilize welded construction and apply the oxyacetylene welding and cutting process to advantage may be grouped as follows:

(A) Purchase of standard equipment of welded construction.

(B) Special equipment designed in the plant and fabricated to specification by outside manufacturers.

(C) Equipment, piping and accessories fabricated by the plant welding department.

(D) Maintenance and repair.

(E) Demolition.

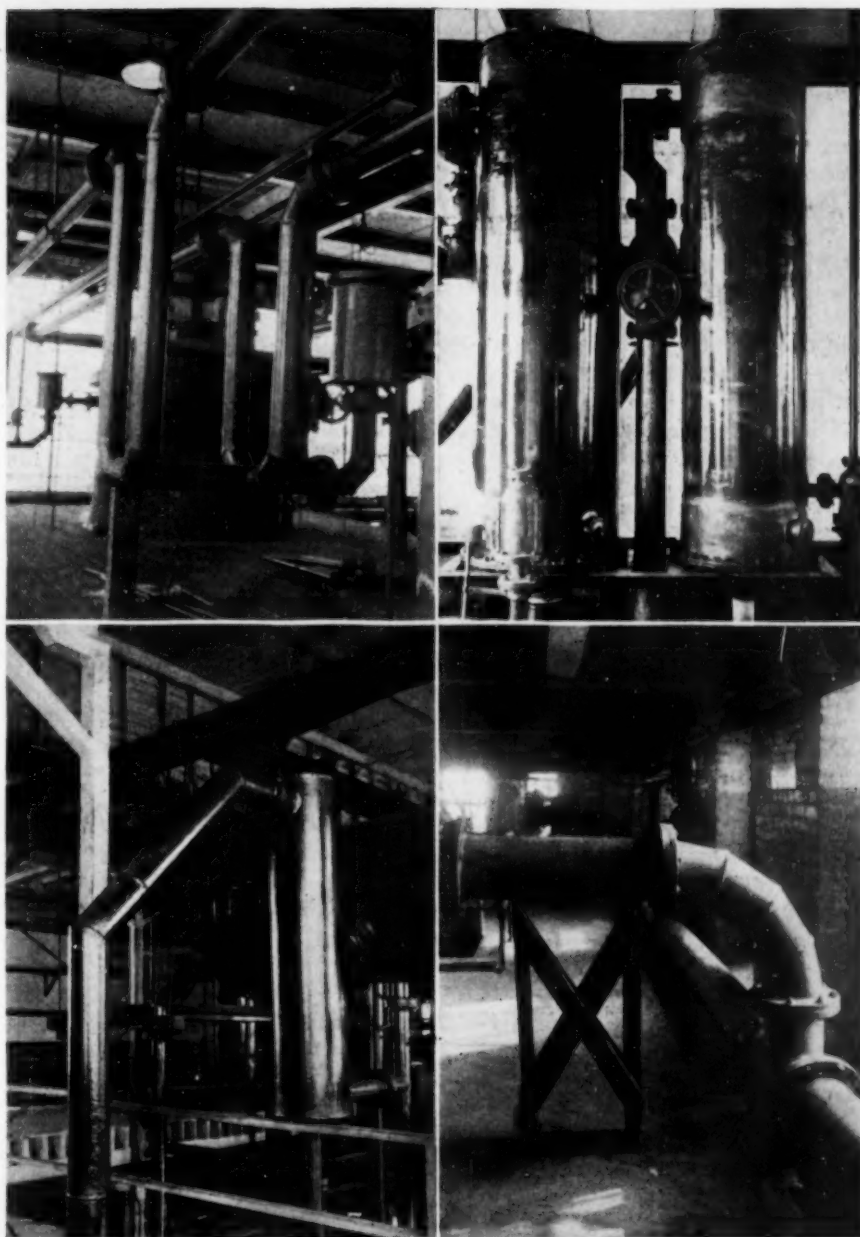
(F) Equipment for small-scale development work.

It is obvious that the maximum advantage of welded construction can be obtained only where there is a definite degree of welded-mindedness among those responsible for plant construction and operation. The chemical engineers responsible for design of plant equipment should be thoroughly familiar with the principles of welded design and sufficiently familiar with welding practice to know that their designs will be in accordance with correct welding procedure. There also should be a welding shop or department capable of handling many of the construction details, such as piping, and also of taking care of general maintenance and repair work.

Standard Welded Equipment—At the present time a wide variety of standard chemical equipment is of welded construction. For the processing, storage and transportation of food products, pharmaceuticals and fine chemicals that would be contaminated by contact with metal, enamel-lined equipment is extensively used. The steel base to which the vitreous enamel is fused is fabricated with welded joints because this type of joint will take the enamel successfully.

Other standard equipment of welded construction includes heat exchangers, condensers, stills and jacketed kettles, including those of copper, nickel and Monel metal; also indirect heating systems using circulation of hot oil as well as jacketed piping, storage tanks, drums and shipping containers of various types.

Special Equipment—The chemical engineering indus-



*Special Fittings Built up for Connecting Battery of Absorbers
Welded Construction Used Here in Connections to Vacuum Evaporator*

*Special Welded Elbow for Space Too Small for Standard Elbow
Lead Fittings in Sulphite Digester Blow-off Line Made by Welding*

tries require much special equipment designed by the plant engineers in charge of such work. Some of this equipment can be fabricated in the plant shops but a great deal of it will have to be ordered from outside manufacturers. These designs must obviously be carefully worked out to insure parts being of a size for convenient handling in the plant.

In designing special equipment the plant chemical engineer may require the services of a capable welding engineer in order to make certain that his designs are practicable from the standpoint of the fabricating shop. For example, co-operation by engineers of the Linde Air Products Company resulted in the development of procedure controls for welding which made possible the fabrication for one group of plants of more than 200 oxwelded pressure vessels all of which have proved to be perfectly satisfactory under operating conditions.

Oxwelded construction is being used also for a wide variety of processing equipment. Among these are ab-

sorbers, condensers including some designed for pressures as high as 600 lb. per square inch, stills, autoclaves, scrubbers and fractionating columns.

Equipment Fabricated at the Plant—In order to take full advantage of oxwelded construction a plant welding shop or department is essential. With the exception of special equipment, much of the construction work can be done by the plant welders. In a large chemical plant there are many miles of piping connecting the various pieces of equipment and the installation of all these lines can be handled by the plant welders. Particularly fortunate is the ease with which special fittings can be fabricated from standard pipe by oxyacetylene welding. This is important in chemical plant work especially, as the piping is of necessity very complicated.

The welding department can also fabricate the various headers, coils, scrubbers, traps, drips and similar items that are required in large numbers at every chemical plant. Since the newer nickel chromium alloys are now being extensively used for high-temperature work, the welding shop should be able to handle these in various forms. Welds in these special alloys operating continuously at temperatures above a red heat are striking proof of the fact that a properly made weld is not affected by high temperature.

In addition to work on equipment and piping the welding shop can also fabricate a large variety of what might be termed accessories. These include supports for tanks and coils, pipe brackets, pipe supports and hand rails. Also, in certain branches of the industry, the oxyacetylene welders, rather than lead burners, are required to handle lead as part of their regular work. In several large paper and pulp mills the welders have become very expert in fabricating flanged lead piping and special fittings used for handling sulphur dioxide and for con-

structing the blow-off lines from the sulphite digesters.

Maintenance and Repair—Owing to the severe operating conditions in the chemical industries, maintenance is a serious problem. Where breakage occurs repair is handled by the welding shop wherever possible and when the open flame is safe. In this connection it is interesting to note that there has recently been placed on the market a portable device for detecting the presence and concentration of certain flammable gases. The use of such a device before welding or cutting in any suspected location would seem to be a sensible safety precaution.

Demolition—Chemical processes are constantly changing, particularly in certain branches of the industry, and as a result equipment is continually becoming obsolete. Small items of equipment usually can be salvaged and disposed of without difficulty, but, as in other industries, the heavy equipment must frequently be demolished in order to make room for newer designs.

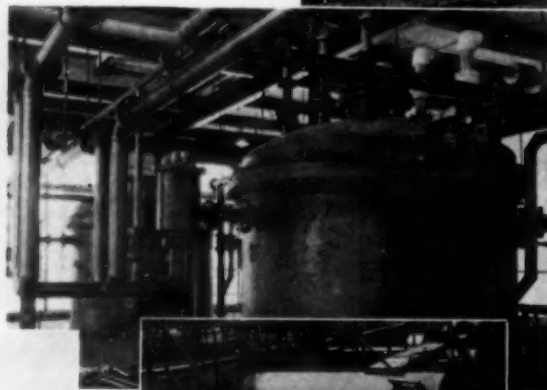
Equipment for Development Work—Before new processes can be placed in actual production, they must first be tried out on a small scale, using instead of the glass laboratory apparatus materials of construction that will be encountered in plant work. Corrosion problems seldom enter into laboratory work in glass but the question of the proper material to use in the plant may require long and careful study as well as the development of new types of equipment. In much of this development work, the oxyacetylene process can give valuable assistance.

Although welding is being used to a considerable extent in the process industries, relatively few plants have reached the ideal utilization that has been outlined in this paper. The welding industry can aid further progress by making available data that will be helpful to chemical engineers and to manufacturers who fabricate welded chemical equipment.

Below, Welded Process Vessels. Note Welded Gage Columns



Below and Lower Right, Top and Bottom Portions of 8 x 40 ft. Absorber Installed



Below, Welded Storage Tank for 125 lb. Working Pressure



Above and Left, Batteries of Welded Pressure Tanks



Defeating HCl Corrosion in Chemical Processing

By Sidney Schein

Cleveland Wire Division, General Electric Company,
Cleveland, Ohio

THERE IS NO QUESTION but that hydrochloric acid is one of the most difficult of all process materials to handle, especially where it must be used hot. Hence the present article is particularly valuable to every engineer who must use HCl in some stage of his process. Taken with a previous article by Mr. Schein, published in the November, 1928, issue, and dealing principally with the storage and handling of HCl, the present paper will be found to constitute a singularly complete discussion of the materials that can be used with this difficult acid.—THE EDITOR.

HYDROCHLORIC ACID is one of the most difficult of corrosive materials to handle in the plant, especially when it is hot. It attacks practically all metals and alloys commercially existent, it fumes easily and the fumes are destructive. Processing material with HCl involves not only the container problem but also the problems incidental to handling the fume, the waste liquors, drying of the product, ventilation of processing tanks and plant, drainage of plant, and the protection of the plant buildings and apparatus with which the acid and vapors come in contact.

In the manufacture of tungsten, which is used for various fabricated products, the intermediate product, tungstic oxide, is obtained from its ores by a process involving the use of both hot and cold HCl. Since the oxide must be of high purity, and since it is of a very absorptive nature, it is evident that its processing must take place in such a manner that no impurities are introduced during the various treatments. It is obvious that no container can be used in the various steps that is not extremely resistant to the action of either hot or cold HCl or its fumes. The following article describes briefly the various methods and installations used in processing tungsten oxide from the standpoint of equipment resistant to corrosive action.

PROCESSING TANKS

In the processing with boiling dilute HCl (specific gravity 1.115 at 20 deg. C.) wooden tanks of quarter sawed cypress are generally used. These tanks vary in size between 1,000 gal. and 3,000 gal. capacity. They are of 4-in. material and are heavily banded. It has been found advantageous in the case of tanks where there is danger of slopping over, to cover the iron bands with lead pipe and to fold a sheet of lead over the draw bolts and lugs, affording good protection for the threads and yet making inspection easy.

There also are used hard-rubber-lined steel tanks up to 1,000 gal. capacity. This type of tank has been in service over two years and so far has needed no maintenance. In the light of its performance, it is probably

the most satisfactory tank to use for large-scale work. Such tanks can be obtained in much larger sizes.

Jacketed steel kettles, glass lined, also have been used. In large sizes these have not been so satisfactory and their first cost is high. The lining is fairly fragile and a dropped monkey wrench or a piece of iron can play havoc with such a lining. For small batch work they are indispensable, as it is possible to control the heating better and to avoid dilution as is done when heating by injected steam. Not all linings are suitable and the purpose for which the kettle is to be used usually is specified.

In order to heat the acid in unjacketed processing tanks it is necessary to inject steam. Several methods have been used, but with the exception of one, have proved more or less unsatisfactory. Stoneware pipe has been used, but is too fragile. Wooden pipe made by coring out the center of a 4x4-in. piece of wood was fairly satisfactory, but its life was short due to cracking and splitting. Extra heavy hard-rubber pipe proved to be too soft at this temperature. The present steam injectors are of iron pipe covered with a special hard rubber. These are made from ordinary 1½-in. extra heavy pipe, lined inside and out with rubber. They are threaded at the end where they are to be connected to the steam line. Superheated steam at 450 deg. F. is run through these injector pipes and they are standing up very well. A pipe will average over six months' service when properly constructed. It is important when fabricating these pipes that no patching be done and that the joining of the inside and outside lining be brought down well below the end of the iron pipe.

It also has been necessary thoroughly to agitate the acid during processing. This is done by means of a paddle, the arms extending nearly the full diameter of the tank. This paddle also is constructed of steel covered with hard rubber, and such paddles have given one and two years' service. Failure usually occurs from abrasion at the ends of the paddle, and occasionally by cracking at the joint. This last type of failure, however, has largely been overcome.

The wooden tanks are equipped with stoneware valves for removing the contents by gravity. These valves are of the straight-bib type and are threaded at one end and screwed into the tank. It is best to build a wooden frame around the valves as a protection against accidental breakage. The rubber-lined tanks are provided with a flanged opening to which a flanged stoneware valve may be fastened. One hard-rubber-lined tank is equipped with a bottom opening to which is connected a rubber-lined spud, or piece of pipe. A cone-shaped piece of hard rubber operates in this spud to shut off the flow when desired. It is controlled by a rod passing

through a stuffing box. The outflow passes through a Y in the side of the spud.

FILTERING

The product of the processing is in the form of a thin slurry containing 25 per cent solid material, the balance being HCl of 2-4 per cent strength. This material is filtered on atmospheric filters which can be either of stoneware, wood, or steel covered with rubber. Stoneware filters present the difficulty of small size, heavy weight, and comparative fragility. Neither wood nor rubber-covered filters have all these disadvantages.

The wooden filters used are of 4-in. cypress in the form of a rectangular box. They are of splined construction, well braced, and tied together by means of steel rods passing through the center of the wood sides and end pieces. The rods are thus fairly well protected from action of the acid. It is better to have the tierods of acid-resisting alloy, for in a few cases the bottom tierods have failed due to acid penetration of the wood. The box is divided into two compartments, upper and lower, by means of removable boards perforated with a large number of $\frac{1}{8}$ -in. holes. The boards act as a support for the filter cloth. Openings are provided for the removal of waste solution and for vacuum leads. Single and double layers of cotton cambric are used for the filter cloth. Such cloths last for weeks.

Hard-rubber-lined tanks of similar construction may be used, and have the advantage that they do not soften as do the wooden tanks. Hard rubber is more advantageous than soft rubber in that hot solutions may be filtered as well as cold.

It is possible to use a wood plate-and-frame press, or one of the newer rubber-covered filter presses, but the use of such apparatus gains very little, as many times the tungstic-acid product filters with such difficulty that the major portion of the waste liquor is better removed by allowing the solids to settle and then decanting. The residue then filters extremely slowly and the solution removal is hastened but very little by increased pressure.

DRYING

The product after filtering frequently contains as high as 50 per cent moisture by weight, and forms a solid cake. It is desired to obtain a production containing not more than 7 per cent moisture, and therefore it is dried in gas or steam ovens. The product contains approximately 50 per cent by weight of 2 per cent HCl. The ordinary gas ovens, which usually are built of iron, rust out very quickly when this material is dried in them. Acid-resisting sheet metals do not stand up well in such apparatus because there always is more or less flue gas and air passing through the oven with the acid vapors.

The most successful driers have been either of wood or brick, heated by steam. The steam coils are not attacked as long as they are hot, so that the HCl vapors cannot condense on them. One type of brick oven consists of arched compartments, the steam pipes forming the floor. Dishes of the wet product are placed directly on the steam pipes. The end of the oven is connected to a brick chimney which vents through the roof. The oven is kept permanently hot and practically no trouble is experienced from spalling or chipping. Ordinary firebrick laid with acid-proof cement were used in its construction. It has been very satisfactory.

Another type is a wooden tray drier of the "Cyclone" type, the air being partially recirculated by means of a

steel fan. The oven is tied together by means of copper bolts and screws. This drier operates at a temperature of 130 deg. C. and has been in service over four years. Neither fan nor steam coils exhibit more than the slightest indication of corrosion, although several metal stacks of acid-resisting metals have been replaced. Here again the reason is that the oven parts have been kept hot while in contact with the acid vapors.

A third drier is another of the recirculating, steam-heated type, lined with a sheet acid-resisting alloy that is claimed to be extremely resistant to HCl. During use, this sheet alloy becomes coated with a grayish green salt which gradually accumulates and must be removed to prevent contamination of the product. The depth of penetration is not great, but the constant cleaning is annoying. In a drier of this type one must be careful in the design that as few joints or contacts as possible of iron or other metals are made with the lining. At every contact of this kind galvanic currents are set up, and the corrosion at the point of contact therefore is greatly accelerated.

In connection with drying, much difficulty has been experienced in obtaining a proper tray or dish. Silica, crockery, wood, even rubber, have been tried without much success. Silica and crockery are too fragile. Wood soon softens and splinters, rubber hardens and cracks. The most satisfactory container has been devised from a graphite composition of the type from which graphite crucibles are made. This material is formed into a flat dish. When received the dish is "painted" with a thin paste of tungstic oxide which adheres quite firmly and prevents the charge from coming into direct contact with the dish. These dishes are very rugged and have proved satisfactory.

VENTILATION

HCl fumes readily and, since these fumes are so corrosive, provision must be made for their removal. There are two types of ventilation system in use, natural draft and forced draft. In this case of handling HCl fumes natural draft is the most satisfactory. The stacks usually are built of wood for, if properly constructed and designed, they are not only the most satisfactory but the least costly installation.

The ordinary type of wood stack will not do. Stacks must be carefully made and of the best workmanship. All joints should be dovetailed, carefully fitted, then fastened together by means of brass screws. Cypress is the best material to use. Longer life will be obtained if the wood is given a good coat of pitch, asphalt, or paraffine on the inside. An exceptionally long-lived stack was constructed of octagonal form, each joint being covered on the outside by a grooved strip running longitudinally. After being fitted and before putting the stack together, it was given a heavy coat of paraffine on the inside. It was then fastened together by means of brass screws. This stack has been in use over six years with no maintenance other than an occasional coat of paint. It is still in good condition. Stacks of ordinary construction last approximately six months under identical service.

Another type of satisfactory stack material is wooden piping. There are several kinds: staves banded together with iron or acid-resisting alloy bands, wire-wound staves, and finally, wire-wound staves coated with a bituminous material of $\frac{1}{4}$ - to $\frac{3}{4}$ -in. thickness. This last type is most excellent as a stack. It needs no maintenance and has been in use nearly three years

handling hot HCl vapors with no indication of deterioration.

When installing natural-draft stacks, precaution must be taken to have straight runs to the air, or when this is not possible, to use large-radius bends. Sub-stacks leading to the main stack should be few and some means should be provided for closing off sub-stacks when not in use. A system installed with these precautions is handling the vapors from boiling HCl processing so well that there is no discomfort to the operators and no fumes can be detected.

Brick and tile stacks can be used under some conditions, but as a rule they are too inflexible to be connected directly to processing apparatus. They cannot be used whenever vibration is present.

In cases where natural draft cannot be used on account of structural or other difficulties, a forced-draft system may be used. For this purpose the silicon-iron alloys have been employed. A blower of silicon-iron may either be connected to wooden stacks or to large-diameter pipe of the same alloy. The blower ejects to the air. An installation of this type has been used over five years with very good results. Such an installation is necessarily more expensive than the natural draft, but it is very effective and very satisfactory, as well as more flexible than the natural-draft system. It has the disadvantage of demanding more care because of moving parts.

DRAINAGE

After processing tungstic acid with HCl, it is necessary to wash it thoroughly with water containing 2-4 per cent HCl. This entails the handling of comparatively large volumes of this dilute acid, as well as the waste processing acid of higher concentration. All of this must be passed through the plant drainage system. The processing apparatus is mounted at various levels and, due to the many moving and rotating parts, considerable vibration is set up. This has tended to complicate the drainage problem, as under these conditions much difficulty has been experienced in maintaining tight joints in the average "acid-proof" materials.

Three different installations have been used: tile, silicon-iron alloy, and soft rubber hose of large diameter. Tile was unsatisfactory. The material comes in comparatively short lengths, necessitating many joints. These joints must be made with some form of acid-proof cement, or asbestos and pitch. The tile must be hung exceptionally well. In spite of all possible precautions, much trouble was experienced from leaky joints. The constant vibration was chiefly responsible. Moreover, tile is fragile, and whenever used near the floor levels must be boxed in for protection. Flanged stoneware using extra heavy soft-rubber gaskets has been used in one installation and has worked out very well. It has been necessary, however, to use extreme care in hanging.

The silicon-iron alloy has proved excellent when properly installed. This material must also be well braced and supported. Under excessive vibration conditions it has been necessary to make a loose connection at the floor fixture by slipping a larger drain pipe around the nozzle of the fixture. There are two types of pipe, the bell and spigot type, and the split-flange type. The bell and spigot joint is of the so-called permanent type; the split-flange joint is more flexible. One point to be noted where the drainage system handles solutions of various temperatures is that allowance must be made

for expansion, as the expansion of the alloy is approximately three times that of cast iron. While the silicon-iron alloys are brittle, they are of sufficiently rugged construction to withstand considerable abuse and no special precautions have been taken around the floor levels.

Another very satisfactory drainage material has been soft-rubber hose. This hose is of approximately 4-in. diameter and is composed of several layers of rubber-impregnated fabric, with a soft-rubber lining inside and out. It is of fairly thin wall section. No particular precautions have been necessary in hanging. Iron or acid-resisting alloy straps have been used. The hose is fastened to a silicon-iron fixture at the drainage point by means of brass clamps. When it is necessary to make a joint in the hose, a hard-rubber insert and brass clamps are all that are necessary. There is no trouble due to vibration or expansion, and no special precautions need be taken for hanging or for protection. The final cost is low, and this drain is remarkably free from maintenance trouble. Such an installation has been in use over four years.

PLANT PROTECTION

All floors on which apparatus carrying HCl is installed are covered with mastic, a gravel and asphalt composition. A depth of from 1 to 1½ in. has proved sufficient. The floors are sloped to the drainage fixtures and are protected at the edges by mastic gutters. The drainage fixtures are embedded in the mastic. This type of floor is acid-proof and wear-proof. An installation five years old is just beginning to exhibit signs of wear, but apparently will last for many years more.

In a chemical plant of this type, paint is not only a thing of aesthetic beauty but a vital necessity. It is here that the slogan of the Paint and Varnish Association, "Save the surface and you save all," is exemplified to the highest degree. Any of the more common acid-proof paints are satisfactory. They usually are of an asphalt base, ordinarily black. The surfaces must be dry, clean, and free from corrosion. The paint should be applied liberally and allowed to dry thoroughly before applying the second coat. A fixed schedule of repainting should be carried out as the asphalt paints "wear" and disappear. It is only by constant replacement that satisfactory results are obtained.

Bentonite Suitable for Manufacture of Pencil Leads

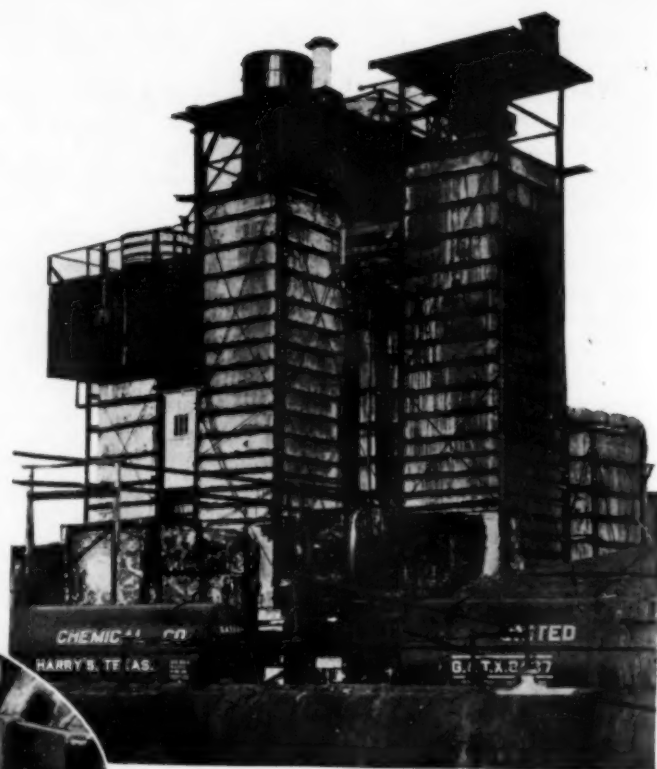
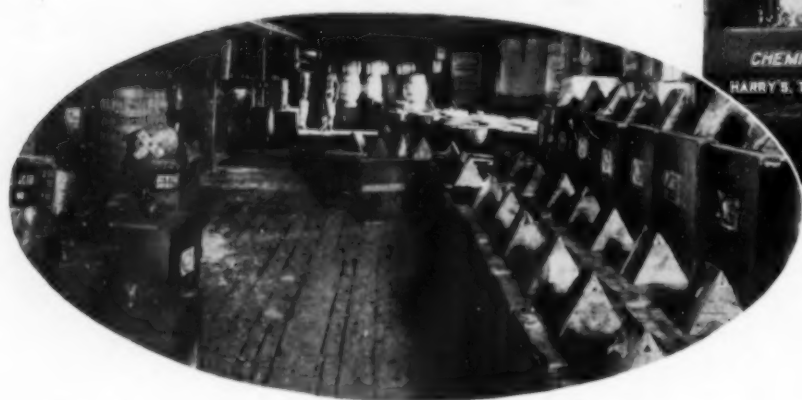
The clay for pencil leads must be absolutely free from grit, and, to achieve this, long grinding or a costly refining by endosmotic means is necessary, says the United States Bureau of Mines, Department of Commerce. Purified bentonites probably would be admirably suitable for the manufacture of pencil leads, and some of the large pencil companies are understood to be using this material already for indelible leads and crayon work, thus saving considerable in grinding cost. The use of some other wetting agent would eliminate the excessive drying shrinkage resulting from the use of water with alkali types. The manufacturers of indelible leads, crayons, pastel colors, and the like, where grease or wax is used in the mix, would find bentonite of considerable value as a constituent of their products.

New Southwest

Bids for

CHEMICAL

DEVELOPMENT



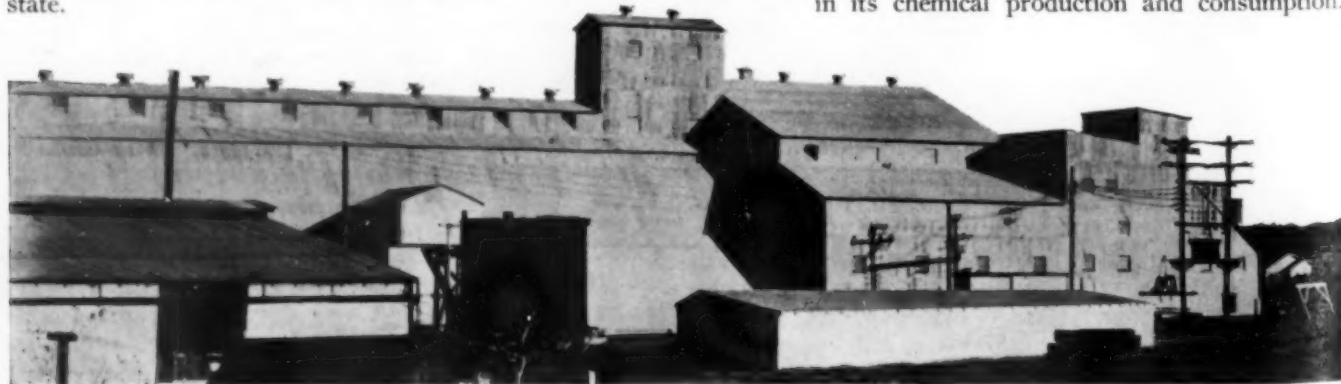
The United Chemical Company's plant at Dallas is built around the 50-ton sulphuric-acid plant shown above. A section of the carboy storage appears at the left and the new superphosphate plant at the bottom.

RICH DEPOSITS of raw materials which will some day make the great southwestern area of the United States an important factor in chemical industry cover a substantial area of Texas. Sulphur and oil, of course, are at present the most exploited of its natural chemical wealth. Sulphur is responsible for the establishment of a number of sulphur-using industries within the state, of which three, one each at Houston, Port Arthur and Dallas, have sulphuric-acid plants.

The pictures reproduced here are from the plant of the United Chemical Company at Dallas, which produces sulphuric and nitric acids and superphosphate. The company, starting modestly in 1922 with a capitalization of \$30,000, has grown within the last seven years to become a quarter million dollar concern with an annual output valued at half a million dollars. Three years after the sulphuric-acid plant was completed, a nitric-acid plant was found necessary. In 1928 a \$100,000 superphosphate unit was added, bringing the plant to its present state.

The sulphuric acid is produced in a chamber plant having a total daily output of 50 tons of 66 deg. Bé. acid, requiring for its production about 34,000 lb. of sulphur. The sulphur, of course, is produced within the state. Sodium nitrate for the production of nitric acid is received by water via New Orleans and phosphate rock from Florida, by water via Tampa and Houston. The phosphate rock consumed amounts to 6,000 to 8,000 tons per year and the company has found the fertilizer outlook within the state to be such that it contemplates the purchase during the year of a sailing vessel for transporting the rock from Tampa to Houston.

The supply of unskilled labor within the region is said to be particularly favorable. The majority of the 30 employees of the company are Mexicans, and the remainder technically trained men, both of which classes are readily available in the Southwest. With ample labor and a particularly rich natural heritage, the Texas region should not be long in attaining a suitable balance in its chemical production and consumption.



New Developments in Gas Making

An editorial interpretation of new processes
and technical trends revealed by Production
Conference of American Gas Association

By *R. S. McBride*

Assistant Editor, Chem. & Met.

EDITOR'S NOTE—In reviewing the proceedings of the 1929 A.G.A. Production Conference no attempt has been made to give credit to individuals or to particular committees for their contributions to the discussion. Instead, the effort has been to present merely a composite impression of the outstanding technical trends shown in this conference, particularly those trends which are of significance to the many chemical-process industries which use gas for process-heating operations. The opinions expressed or implied by this discussion are those of the writer himself; they should not be assumed as necessarily reflecting the opinions, either expressed or intended, by the speakers at the conference.

INCREASED efficiency and modified methods of water-gas making have restored to this branch of the manufactured-gas business prestige and opportunity for further expansion. This conclusion seems inevitable from the highly important disclosures of research results and operating technique presented at the Production Conference of the American Gas Association, held in Baltimore, Md., at the end of May. In fact, one studying the material offered at those sessions and undertaking to interpret it must inevitably be struck with the possibility that the pendulum has swung too far toward coal gas and that perhaps we are not going to have coal-gas base-load plants everywhere for city-gas supply, as seemed probable only a few months ago. Users of industrial gas who will benefit by lower cost in fuel supply, as well as producers, should, therefore, interest themselves in the meaning of the technical conclusions presented at this conference.

The advances in water-gas making disclosed by various committee reports and papers presented at the conference include improved efficiency from automatic operation, more effective methods for use of bituminous coal instead of coke as solid fuel, new research results on the degree of steam decomposition in the generator, improved technique for the making of water gas with low specific gravity which can better be mixed with coal gas, and additional information regarding utilization of propane and butane from natural gasoline and rich gases from petroleum refinery stills instead of oil in water-gas enrichment. The work of the chemical committee, particularly that on the evaluation of water-gas oils, also affords significant results encouraging to the water-gas branch of the business.

Automatic manufacture of water gas, one of the large contributing factors giving added economic life to this method of gas making, came in for extensive discussion. The methods employed and the general significance of the trends toward automatic equipment have been described recently in *Chem. & Met.* (page 205, issue of

April, 1929). The advantages of these developments were fully disclosed by the sub-committee report, from which the following conclusions may safely be drawn:

Automatically charged water-gas machines have approximately the same efficiency of oil use as non-automatic machines, or in a few cases a very slightly lower oil efficiency. The solid fuel used per 1,000 ft. of gas made is less by from 0.5 to 3 lb., depending on the quality and kind of fuel used. The capacity of automatically charged and automatically clinkered machines is increased by from 7 to 25 per cent, primarily because of the saving in clinkering time. Although costs of maintenance of the equipment are from 15 to 100 per cent more for completely automatic sets, yet the total cost of operation is less—the net saving per year per automatic machine varies from \$5,000 to \$17,000 for the plants reported on. There are other advantages than these financial ones which accompany the installation of automatic charging and clinkering equipment, the most important of which are cleanliness of operation and improved working conditions for employees.

REDUCED COST of solid generator fuel can best be afforded by use of bituminous coal instead of coke in water-gas making; hence this feature of recent developments is of large economic significance. However, before adopting bituminous coal the plant operator must be assured of adequate gas-making capacity, freedom from smoke, reasonably low percentage of inert constituents in the gas, a gas of the same or lower specific gravity, lower cost for solid fuel or for oil, or both, and maintenance and capital charges increased, if at all, by so little that the net result is an over-all saving.

The results reported at the conference show that all of these requirements can be met, but usually not all at the same time with entire satisfaction. For example, the maintenance of low inert content and low specific gravity prevents use of the blow-run in gas making; and the elimination of the blow-run in turn reduces the gas-making capacity of a machine. Where slight increase in inerts and slight increase in specific gravity can be tolerated, machine capacity can be maintained almost, or fully, up to coke capacities. Under these circumstances, a slight saving in over-all gas cost can be made, even with coal and coke at the same price per ton, because the weight of fuel consumed per 1,000 ft. is slightly less with coal than with coke. Furthermore, if the coal price is less than the coke price, which usually is the case, a still larger saving is possible.

In order that all of the industry may benefit from the successful results obtained by any operator in using

bituminous coal, the committee investigating this development has obtained reports from a large number of companies on all successful trials. From these reports the committee has tabulated the names of all bituminous coals which have been reported to it by any manufacturer of gas as suitable for water-gas use. Hence, any operator who contemplates a change to coal has a list of fuels which have already been proved satisfactory. He can thus feel sure that if he does not at the first attempt get satisfactory results with such coal, it is a matter requiring change in his operating technique rather than change in his fuel.

LOW SPECIFIC-GRAVITY water gas, mentioned several times as desirable, is essential if the maximum freedom is to be had in choice of the proportions of coal gas and water gas in a mixture for city supply. It is now evident that gas users in industry as well as household users require as much attention to uniformity in gravity as to uniformity in heating value. Industrial burners functioning satisfactorily on one mixture are likely to become out of adjustment and seriously unsatisfactory in performance if the specific gravity changes more than 10 per cent, or perhaps 20 per cent in some special cases. As a consequence, the manufacture of low specific-gravity water gas, which can safely be mixed in all proportions with coal gas, is an important objective sought by investigators.

Results reported by Willien and Stein less than two years ago gave very great stimulus to these investigations because they showed a successful method for making low-gravity water gas by introducing the carbureting oil during the back-run portion of the gas-making cycle. At the recent conference further very specific results were reported on development of this and related procedures. These developments are of great importance, not only for those making mixed gas in varying proportions but also for those water-gas manufacturers who desire to use high-gravity enrichers, such as propane-butane mixtures or heavy oil-refinery still gases. (These latter developments are discussed later in this report.)

Results obtained by several companies seem conclusively to demonstrate that the specific gravity of carbureted water-gas, which is normally about 0.65, can be reduced to 0.55 by thoroughly practical methods of plant operation. When a water-gas set is operated to give this result it has a largely increased gas-making capacity, but, unfortunately, it results in a somewhat increased consumption of both solid fuel and oil, amounting to nearly 6 cents per 1,000,000 B.t.u. in the gas, or approximately 3 cents per 1,000 cu.ft. of 530-B.t.u. gas. Because of the increased set capacity there is reduction in labor cost and in fixed charges offsetting the increased fuel cost, so that the net increase is small, perhaps as low as one cent per 1,000 ft. Hence, this new method of water-gas making is entirely feasible economically, especially for gas making at times of peak send-out, when the required increase in proportion of water gas would without this development occasion serious gas-using problems.

A still further reduction in specific gravity below 0.55 is recognized as feasible technically, but probably economically unwarranted. Where the use of still lower gravity water gas seems desirable an alternative procedure to this method is to increase the specific gravity of the coal gas throughout the year by increased admixture of either water gas or inerts. By such a scheme it is possible to maintain uniformity of specific gravity with the minimum net year-round cost under certain circum-

stances. Each locality, of course, has its special conditions to consider, and each management must, therefore, study the several alternative possibilities for maintenance of uniform gas gravity in order to get satisfactory burner behavior most cheaply.

MORE PRECISE evaluation of gas oil is now possible because of the thorough investigations made by various chemists, notably T. A. Mighill, of Pawtucket, R. I. Practical operation confirms the earlier conclusion that there is a substantial difference in efficiency of use for carbureting water gas of the four groups of constituents which make up a typical gas oil. As a result, one or the other of two procedures now seems to be recognized as essential for intelligent selection from gas oils offered by various producers.

It is indicated that the four groups of constituents should be appraised in purchasing with credits according to the percentage efficiency with which they may be converted into gas in a typical water-gas machine. Paraffine types of constituents, even those of rather waxy character, are of the highest efficiency, being rated at 80 per cent. The naphthene group has a rating of 70 per cent, the aromatics of 60 per cent, and the unsaturated constituents of 25 per cent. Either the percentage of these various constituents must be prescribed as a part of the specifications of purchase or purchases must be made on the basis of samples which have been subjected either to chemical tests or to practical small-scale carbureting trials.

THE question of carbureting efficiency of gas oils is one which should concern the petroleum refiner as well as the gas manufacturer. It is pointed out by those who have made studies in this field that very often the gas works merely gets what happens to be left over at the refinery and that the refiner has almost no knowledge as to the relative value of the various topped crudes, gas-oil fractions, and fuel-oil residuals which he may wish to dispose of. He may even offer some of the less desirable of these materials at the higher price because he lacks even that knowledge of the relative carbureting value which could be had from relatively simple and accurately controllable laboratory-test methods. It may be inferred, therefore, that those petroleum refiners who intend to do much gas-oil business will find it advantageous to possess a thorough appreciation of gas-making value of the oils which they offer, since it will often enable them to modify their selling program to the mutual advantage of themselves and the gas maker.

Petroleum byproducts now afford several interesting materials which have received serious consideration by the water-gas maker as gas enrichers. Propane and butane, and their mixtures, have already been described in *Chem. & Met.* as available for this work. These byproducts of natural-gasoline refining are now estimated to be available in such quantities as to afford significant percentages of the required energy for all gas-making work. They may be used for cold carbureting of gas in place of oil, for distribution in vapor form mixed with air, for re-enrichment of gas which has lost heating value during compression and transmission, or merely to aid in meeting the peaks of gas requirements in cities where serious variations in load curve are experienced.

Most experience has been had in the use of propane and butane as a substitute for gas oil in enrichment of blue water gas to the requisite heating value for city

supply. The most elaborate operating results of this sort indicate that these hydrocarbon gases can be substituted approximately gallon for gallon for gas oil and that at an equal price per gallon the cost of enrichment is substantially the same. The technique of using these hydrocarbons has been thoroughly worked out, so that the question of substitution of cold carbureting is wholly an economic one.

In one experience fully reported to the conference these gases have been applied for enriching only such blue gas as is used during peak-load periods for admixture with natural gas. In this case, an extremely interesting and unusual combination has been developed to make an 850-B.t.u. mixture of natural gas, low-gravity water gas, and butane vapor. Apparently in this particular case a very low investment suffices and, hence, an advantageous total year-round cost of gas is achieved by this combination of natural and manufactured gases.

Industrial use of propane and butane for plant heating operations has been developed in some areas very successfully. This threat of industrial use of these natural-gas byproducts as a competitor with city gas is one which evidently disturbs the manufactured-gas business considerably. They realize that if hundreds of millions of B.t.u. come into the industries for heating in these forms the gas companies are inevitably deprived of just that much prospective market for city gas. They are hoping, therefore, that the further development of these products for industrial heating may be made either through their use as city-gas enrichers or for air-gas mixtures, which appear suitable for small communities.

This latter development has been tried out in two small Indiana towns where a mixture of air with propane-butane vapor has been made the successful basis for city-gas supply. This system of supply has been worked out to the point that there is no inherent technical difficulty in the making of a safe mixture for utilization in household or industrial-plant gas appliances.

Similar methods to those used in these small-town gas plants are readily applicable in the isolated industrial works which has heating problems not readily solved by coal or oil and which cannot be solved by city-gas supply because of distance from city-supply mains. At the present time these products are being offered by certain petroleum refiners at prices which compare favorably in cost per 1,000,000 B.t.u. with any other fuel source of anything like comparable efficiency of use. It is a question, therefore, as to whether these liquefied vapors will ultimately find their principal market among industrial-plant users or as enrichers in the city-gas industry. The result, apparently, is going to depend on the type of gas-rate schedules established for industrial users of city gas quite as much as on any other single factor.

For areas near oil refineries there is sometimes available cracking-still gas of from 1,400 to 2,000 B.t.u. per cubic foot and of 1.0 specific gravity, which is uneconomically employed at the refinery as fuel. This affords a very fine enrichment gas for the city-gas maker. Often

this application of still gas warrants a payment to the refiner which substantially exceeds the value to him of the still gases as fuel. The use of this gas can very readily be accomplished along the same lines as those developed for propane and butane, since simple mechanical mixture with the base gas, very lean coal gas or blue water gas is readily accomplished by well-proved methods.

Clean gas, freed from oxygen, cyanogen, sulphur compounds, naphthalene, and even water vapor, is now a recognized essential for ideal gas service. This seems to be a conclusion more and more being taken into account in the planning of gas-making and gas-distributing systems. It is a conclusion which certain prominent engineers of the gas business say has been reached by the large industries gas users also.

The responsibility for producing such pure clean gas is now being placed on the gas-works engineer, who is challenged by the advocates of this trend to consider overall costs and the distribution and utilization problems quite as much as those of concern within the works itself. British experience is cited to show that with proper drying of gas, which has been applied to plants up to 19,000,000 cu.ft. send-out per day, there has been experienced almost complete elimination of distribution stoppages, entire elimination of freeze-ups, and meter repairs reduced by approximately 50 per cent. The saving of the loss caused by internal corrosion of distribution and service pipes is estimated to be much more than enough to compensate for the increased capital charge on a plant arranged to send out dried gas.

METHODS for removal of sulphur, naphthalene, cyanogen, and other objectionable and corrosive constituents of gas are already thoroughly established by extensive American experience. It is pointed out that the modern modifications of these methods, particularly liquid purification, make it unnecessary to have any significant percentage of oxygen in the gas leaving the works. Old purification practice, using iron-oxide purifiers exclusively, generally necessitated the presence of approximately 1 per cent of oxygen in the gas sent out. The advantage of elimination of this corrosive element from the send-out is variously estimated, but it is generally accepted to be a very large factor of saving which should be credited to the newer plant technique.

The percentage of inerts in the gas supply to industrial users is a question on which there remains substantial difference of opinion among gas engineers. However, there are those who seemingly gain increasing support for their idea that the percentages of inerts above 10 or 12 should not be tolerated where they can be avoided by sound technical means that may be locally practicable from a cost point of view. Carbon dioxide is cited by these critics as being particularly objectionable, not only because it is an inert and reduces the efficiency of gas utilization but also because it is a mildly corrosive constituent, contributing to internal damage of the distribution system.

Present trends in the water-gas industry are toward automatic manufacture, the use of bituminous coal for solid fuel, and of propane and butane from natural gasoline for enrichment purposes. These changes have restored prestige and opportunity for further expansion to this branch of the manufactured-gas business.

Automatic Control Developed to Maintain Uniform Density of Suspensions

Viscosity of paper and chemical pulps used in new Bradley-Osbourne controller to govern flow and dilution

IN CERTAIN chemical processes where a substance in the solid phase mixed with a liquid is handled, the property of the "thickness" or viscosity or even the density of the liquid-solid mixture can be advantageously used for control of the flow. Where the change in density with concentration is very marked, this property may be used likewise in the case of homogeneous solutions. Experimental tests recently com-

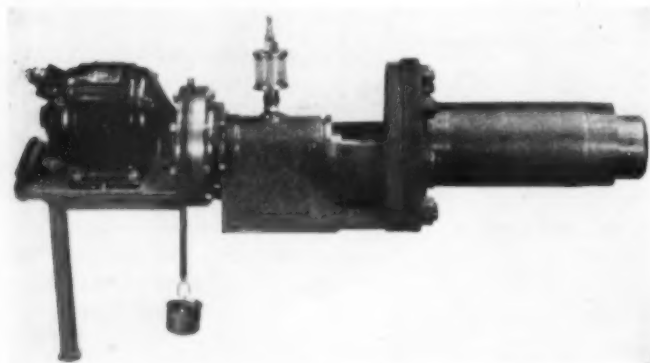


Fig. 1—Bradley-Osbourne Viscosity Control

pleted in several plants on a new type of viscosity control seem to open up an easy method of automatically governing the flow of liquid and holding constant the concentration of solids per unit volume of liquid.

The apparatus (Fig. 1) which has been developed by the Thyle Machinery Company, of San Francisco, and is known as the Bradley-Osbourne viscosity control, makes use of the same basic principle found in the MacMichael viscosimeter. That is, it depends upon the resistance of a solution to a turning cylinder. The resistor is mounted on a shaft geared to the rotor of a small motor, the shaft extending through a specially designed stuffing box of very low friction, into the liquid. The supporting housing for the motor is so arranged that the center of

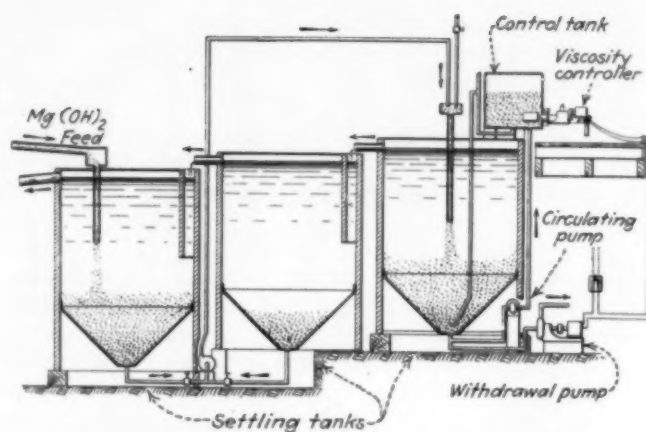


Fig. 3—Washing System for Magnesium Hydroxide Equipped With Bradley-Osbourne Viscosity Control

A pump removes the sludge at the proper density from the third settling tank and discharges it to a crystallizer.

gravity of the motor is above the center line of the shaft. Hence the torque exerted in turning the resistor tends to overbalance the motor. This tendency is counterbalanced by means of a weight extending below the motor base, holding the motor in a vertical position when not running.

In operation, as the resistance to the rotating cylinder

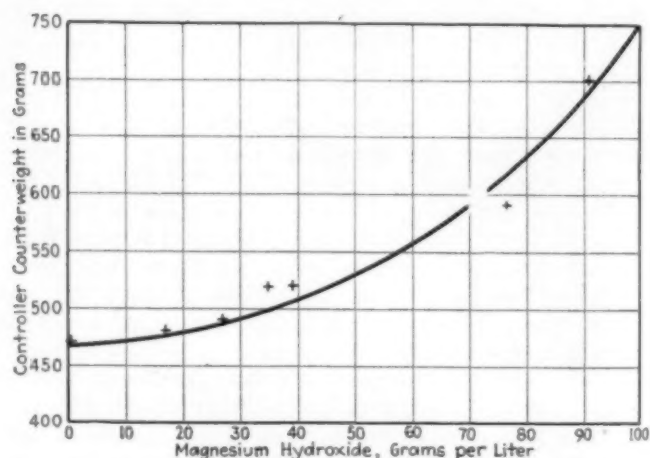


Fig. 4—Variation in Viscosity of Magnesium Hydroxide Suspension With Solids Concentration as Shown by Viscosity Control

increases due to a change in viscosity, density or thickness of the pulp, the motor tends to revolve through a short arc. This movement is used to actuate an indi-

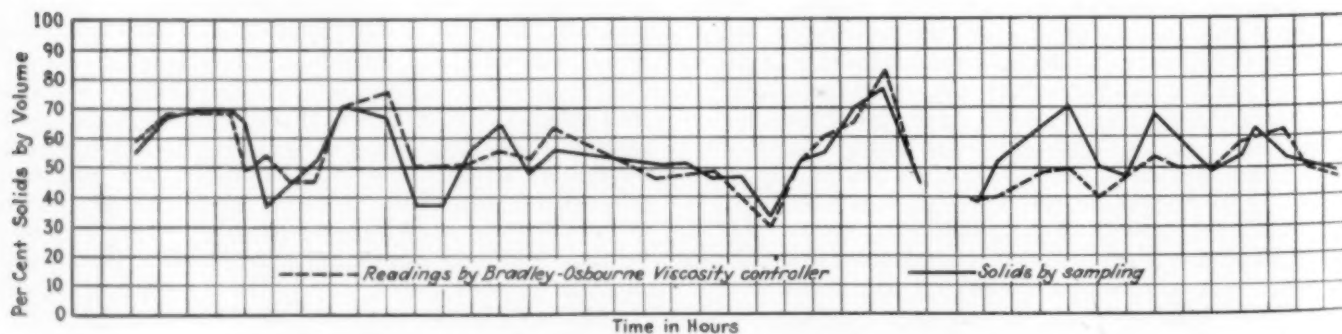


Fig. 2—Curves Showing Variation of Solids in Feed from Crystallizer to Continuous Filters as Determined by Hand Sampling and by Means of Bradley-Osbourne Control

The solid curve shows per cent of solids (NaCl , Na_2CO_3 , Na_2SO_4) taken by settling in a sample bottle, and the dotted curve, per cent determined by the viscosity control

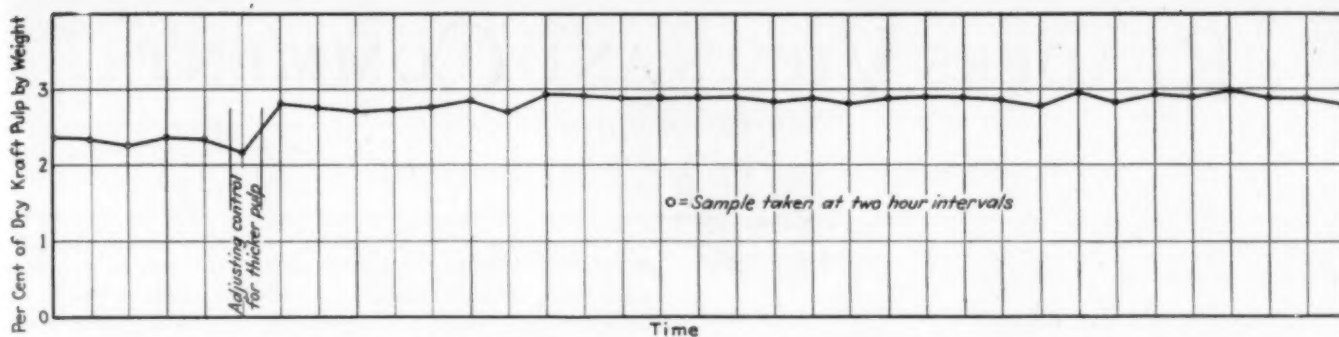


Fig. 8—Showing Uniformity of Pulp Consistency Produced by Controller on Kraft Pulp for Top Liner

cator or warning signal or by means of a mercury switch, to work a motor-driven valve which controls the feed or discharge. Adjustment of the control is applied by means of weights hung from a steel tape wrapped

been used with success also in maintaining constant concentrations of solids fed to a continuous filter. This has given much closer control than could be attained with manual operation.

In the evaporation and concentration of liquids such

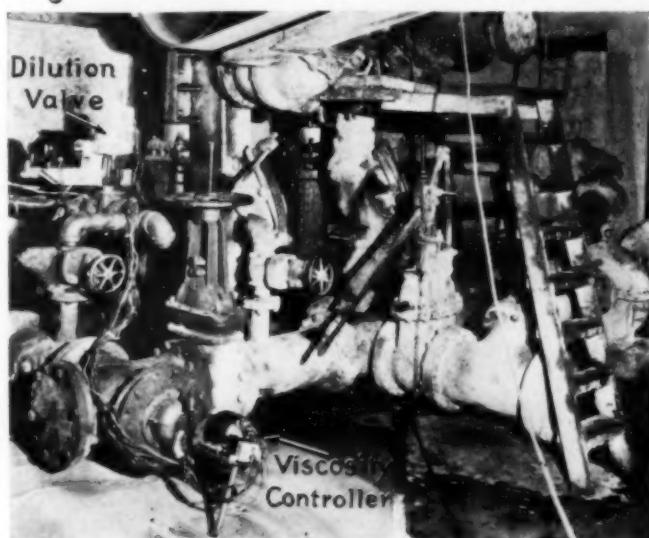


Fig. 5—Pulp Control Installed in a Pacific Coast Paper Mill to Maintain Constant Thickness of Pulp Fed to Jordans

around the gear housing to furnish a torque opposing the tendency toward rotation.

The control has been used in determining the percentage of solids in a slurry. This was accomplished by

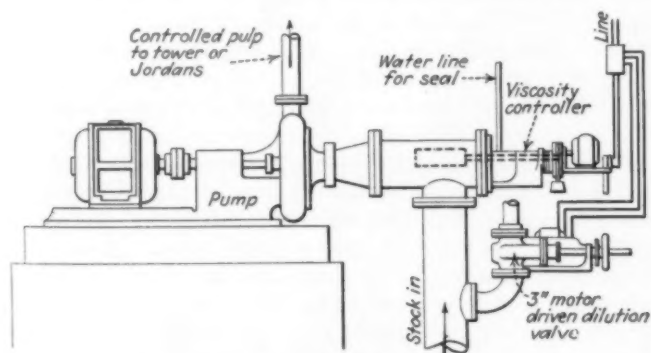


Fig. 6—How Controller Is Applied to Kraft Pulp Control in Paper Mill

adjusting the weights hung from the steel tape so as to keep the motor in balance. A test made at Searles Lake, Calif., operating on a saline slurry containing sodium chloride, carbonate and sulphate, showed decided superiority of the control to the method of hand sampling. Fig. 2 gives the results graphically. The control has

Table I—Typical Data on Control of Evaporation

Batch	Viscosity Raw Pulp (Seconds)	Per Cent Solids by Refractometer	Viscosity Finished Pulp (Seconds)	Per Cent Solids Finished Pulp by Refractometer	Controller Reading
1	4.2	8.4	82	41.0	144
2	4.1	7.9	80	41.4	144
3	5.0	7.8	80	41.4	145

as tomato catsup, this method has been used to control the endpoint of the batch with considerable success in a large California plant, the variation permitted by the apparatus being very small and a uniform product from a series of batches being obtained. (See Table I.) In the gravity settlement of materials of low specific gravity such as $Mg(OH)_2$ the variation in the control attained was between 90 and 100 grams per liter with the apparatus set to operate at 90 grams per liter. Fig. 3 shows the settling apparatus and the way the controller was connected in, while Fig. 4 is a curve showing actual pulp concentration plotted against the amount of counterweight hung from the controller.

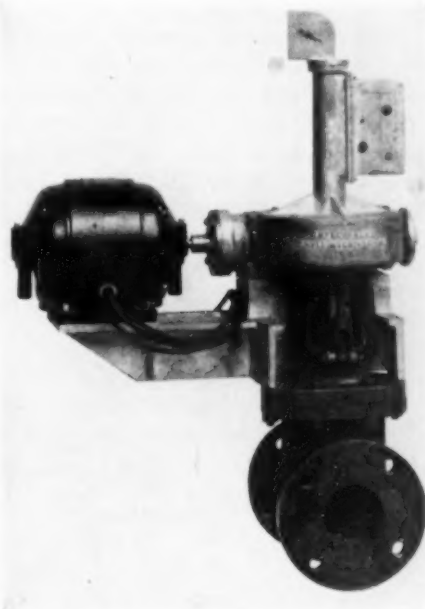


Fig. 7—Rising Stem Type of Thyle Motor-Operated Valve

Up to the present there has been no satisfactory method for control of the amount of pulp in the pulp-water mixture going to the Jordan machines of a paper mill using kraft pulp entirely. One of these controls was installed between the stockchest pump and the Jordan machine in a large Pacific Coast plant and was arranged to control a dilution valve as shown in Figs. 5 and 6. The valve itself appears in Fig. 7. The variation allowed by the control is shown in Fig. 8. An even power load, uniform Jordan operation and a smooth, even stock on the paper machine resulted.

READERS' VIEWS AND COMMENTS

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

The Proposed "Industrial Instrument Institute"

To the Editor of Chem. & Met.:

Sir:—I wish here to amplify the suggestion made briefly on page 245 of the April issue of *Chem. & Met.* This suggestion deals with an organization I should like to see formed in connection with the manufacture and use of industrial instruments. The organization might be known as the Industrial Instrument Institute and should be composed of representatives from the instrument manufacturers, from instrument-using industries, from engineering associations, from purely scientific bodies, from governmental authorities perhaps and also from semi-official bodies such as the A.S.T.M. and the National Board of Fire Underwriters. The organization should preferably be semi-official in character, capable of making recommendations which would be seriously considered by its members. An official publication should probably be published at regular intervals.

The principal functions of the Institute would be:

(1) To provide a central clearing house of information gathered by the engineering research departments of the instrument manufacturers that are engaged in studying the problems of instrument users.

(2) To provide a central clearing house of information for the instrument-using industries where the men in charge of processes would report their own solutions of their own problems.

(3) To provide a means whereby the solution of a process followed in one industry could be brought to the attention of other industries employing the same or a similar process.

(4) To facilitate the standardization of bulbs, sockets and other similar instrument parts as well as of ranges, nomenclature, sizes, scales, markings, charts, and so on. There is great need of this.

(5) To serve as a meeting ground for the various branches of engineering involved in the application of industrial instruments. A purely chemical problem may involve work on the part of chemical, mechanical and electrical engineers in the application of control.

The first three points are more or less self-evident. Functions (4) may seem self-evident except in the matter of nomenclature. It is a fact that nomenclature is not standardized even in some individual companies. Nor is the dividing line between thermometry and pyrometry understood. Such an expression as a "10-inch chart" as applied by different manufacturers to charts having exactly the same outside diameter may mean considerable difference in recording area. These are only two of many possible examples.

While on the subject of definitions I want to take the opportunity of distinguishing between what the instrument industry understands as automatic controllers and other forms of controllers. The proposed Institute probably would not deal with many of the devices known as controllers, regulators and governors which are incor-

porated in engines, turbines, generators and other such machines. These devices constitute essential parts of the machines; they are conceived, designed, built, sold, installed and maintained with the machine; they belong to the machine and cannot conveniently be studied separately. They seldom can function on other machines and consequently should, according to the writer's idea, not come within the scope of the proposed Institute. On the other hand, automatic control of temperature, pressure, humidity, duration of process, liquid level, flow and other conditions of industrial processes is now a recognized science and a branch of engineering. The manufacture of automatic controllers and industrial instruments of all kinds by more than one hundred firms in the United States alone amounts to a sizable and important industry and as such should enjoy some such centralized organization as has been outlined above.

New York City.

M. F. BÉHAR.

* * * *

The Rôle of Control in Shaving Technology

To the Editor of Chem. & Met.:

Sir:—In the advertisements of a certain make of shaving cream we read that, by virtue of its use, shavers may avoid the dreaded hydrolysis. The casual and uninformed reader of such literature gathers the impression that hydrolysis is some kind of pretty bad face itch. The soap in question is said to contain an excess of free fatty acids to neutralize the hydrolyzed alkali in an aqueous soap solution.

The house that puts out the product and the advertisements is an ancient establishment of good repute, and one is inclined to believe whatever it says. But the reaction time of free fatty acids in solution with the slight amount of hydrolyzed alkali bothers me. I don't see how neutralization of the alkali can take place on the shaver's face; it must occur, if at all, in the scraped-off suds late in the afternoon or possibly next day. And few, if any, shavers are interested in their discarded suds.

I think I have discovered the feature which the advertisements have failed somehow to make clear but which would establish the contention that shavers may avoid hydrolysis in using this special preparation. It is that the shaver, previous to or while shaving, should run hot, either by emotion or otherwise, so that he has a countenance-temperature considerably above the boiling point of water. By maintaining this condition during a prolonged period of lathering the "break" or soap-forming reaction should take place. Then, if the shaver felt up to it, he might proceed with the transaction of his day's business in a hospital. Without this preliminary step in thermodynamical shaving, it would appear that he might just as well use some other kind of soap.

Curator, Chandler Museum,
Columbia University
New York.

ELLWOOD HENDRICK.

CHEMICAL ENGINEER'S BOOKSHELF

Changing Tempo of Modern Industry

RECENT ECONOMIC CHANGES IN THE UNITED STATES. A report by the Committee on Recent Economic Changes of the President's Unemployment Conference, of a survey made by the National Bureau of Economic Research. Published by McGraw-Hill Book Company, New York. Two volumes, 950 pages. Price, \$7.50.

Reviewed by S. D. KIRKPATRICK

TWO words, "economics" and "change," have an important place in our present-day thinking. It has been aptly said by Dr. Julius Klein that the front pages of our newspapers have "gone economic." And those keen students of reader interest who guide public opinion through the daily press see more than a passing fancy in this popular demand for economic information. Taxes, foreign debts, wages, standards of living, tariff, and foreign trade concern not only the economist whom we have elected our President but the man in the street or the plant who is now beginning to evaluate these factors in terms of his own job or industry.

In all of these economic forces the element of change is playing the most important part. We are moving at an accelerated pace. Power, mechanization, research, hand-to-mouth buying, improved transportation and communication have all added speed to our normal processes of production and consumption.

All the more important it is, therefore, that we should have this great stock-taking of the factors that make for stability or instability in our national life. That it should come out of the President's Conference on Unemployment of 1921, which has contributed two other national surveys, is fortunate because it has given us a cross-section of one of the most interesting periods in our economic history. Besides recovery from the severe depression of 1920-1, these seven years have seen the beginning of many fundamental changes that have yet to be appraised in their final significance.

Selected to organize the study and interpret the report was a committee of the foremost economists and business and labor leaders headed by President Herbert Hoover and including Walter F. Brown, Renick W. Dunlap, William Green, Julius Klein, John S. Lawrence, Max Mason, George McFadden, Adolph C. Miller, Lewis E. Pierson, John J. Raskob, Arch W. Shaw, Louis J. Taber, Daniel Willard, Clarence M. Woolley and Owen D. Young. Edward Eyre Hunt served as secretary to the committee—just as he had previously served the Hoover Committee on the Elimination of Waste in Industry. The reconnaissance survey to collect the facts on which the report is based were made by the National Bureau of Economic Research under a grant of \$150,000 made available by the Carnegie and Rockefeller foundations.

The committee's classic interpretation of the factual report has already received wide circulation through the daily press, but the real meat of the two volumes is to be found in the twelve basic chapters, the introduction by Prof. Edwin F. Gay, and the summary by Dr. Wesley C. Mitchell. Executives and technologists in the chemical engineering industries will find most of direct and immediate interest in Dean Dexter S. Kimball's "Changes in New and Old Industries" and in L. P. Alford's study of

"Technical Changes in Manufacturing Industries." In the latter, for example, are basic data on the various production factors, a study of industrial research activities and expenditures of forty manufacturing groups, a compilation of fifty typical process developments as well as similar lists of specific industrial examples of waste elimination, reclamation and re-use of materials, by-product recovery, electrification and material handling.

It is unfair to judge such a monumental work by the analysis of a single spot-sample. The book as a whole is worth the careful study of all who are concerned with the future industrial operations of this country. It can be made a useful tool in maintaining the degree of economic balance which the committee recognizes as necessary if our intricate industrial machine is to continue to produce and to serve us as it has during the past seven years.

* * * *

The Romance of Alfred Nobel

NOBEL: DYNAMITE AND PEACE. By Ragnar Sohlman and Henrik Schück. Translated by Brian and Beatrix Lunn. Cosmopolitan Book Corporation, New York, 1929. 353 pages. Price, \$5.

Reviewed by E. M. SYMMES

EXCEPT for some condensation and rearrangement, this book is a translation of the Swedish *Nobel och hans Släkt*, 1926. Although Alfred Nobel visited the United States, he and his brothers were not nearly so well known here as in Europe, where their name is perpetuated in several companies. Also it is not generally known here to what extent the Nobels participated in the development of the Russian petroleum industry.

The translators have performed a valuable service in rendering the Nobel history into English, a more widely understood language than Swedish. In the historical and non-technical portions of the book the translation leaves nothing to be desired as regards accuracy or smoothness, but the same cannot be said of the technical portions. It is too bad that the book is marred by such glaring inaccuracies as tin-plate for platinum foil, hour glass for watch glass, waters for hydrogen atoms, gravel instead of kieselguhr as a dynamite ingredient, Vinterwik for the Swedish village of Vinterviken, dynamite containing an excess or deficiency of acid instead of oxygen, or containing acid-forming instead of oxidizing substances, acid being the very last thing desired in dynamite.

Furthermore, Judson powder never contained sodium perchlorate but did contain sodium nitrate (*natron-salpeter*). Smokeless powder is rendered as comparatively smokeless, or smoky, powder; progressive powder is rendered as propellant powder, thus altering the meaning; Trauzl is translated as Taulz; liquid solvents rich in carbon (*kolrika*) appear as strongly carbonated liquid solvents; but to "raise the temperature of combustion and diminish the wear in the bore" is inexcusable, when the Swedish *sänka* means reduce.

That no chemist assisted is shown by such expressions as corrosive natron for caustic soda, natrium metal, anhydrous sulphuric acid for sulphuric acid anhydride, rarified acid for dilute acid, soluble gunpowder for

soluble nitrocellulose, specific weight for specific gravity, sodium bicarbonate, the water (instead of liquid) in which nitroglycerin forms—but space forbids quoting the 107 errors checked. Where difficult technical terms appeared in the Swedish there was a tendency toward omission, as on page 274: "It is not dangerous when ignited" [because of its low temperature of explosion and short flame]. Omission of the portion in brackets alters the meaning.

Nevertheless, since the historical portion of the book is far larger than the technical portion, the book is excellent reading and very interesting.

* * * *

Cornell Lectures by Walden

SALTS, ACIDS, AND BASES: ELECTROLYTES: STEREOCHEMISTRY. By *Paul Walden*. McGraw-Hill Book Company, New York, 1929. 397 pages. Price, \$4.

Reviewed by GRINNELL JONES

CORNELL'S department of chemistry is very fortunate in having the George F. Baker Fund, which brings distinguished foreign chemists to Cornell to give series of lectures. In this book a part of this good fortune is shared with the rest of us, as well as may be in cold print, by the publication of the lectures given by the famous Paul Walden, formerly of the University of Riga, now of the University of Rostock.

The opening lectures deal with the early history of chemistry with special emphasis on the development of the concepts of acids, bases and salts and brings this subject down to very recent times in order to explain the interesting and novel views of Hantsch and Brönsted. The greater part of the book is devoted to a summary and interpretation of Walden's life-long researches on the electrical conductance of non-aqueous solutions. Especially significant is the emphasis laid on the conclusion that the conductance is a simple function of the square root of the concentration. This generalization is inexplicable on the classical electrolytic dissociation theory of Arrhenius but is in harmony with the modern theory of solutions which is now rapidly winning its way. The concluding part of the book deals with the early history of stereochemistry which leads up to a fascinating account of the remarkable Walden Inversion.

Although Walden is old in years and in achievements this book demonstrates that he is still young in mind because he can and does present the latest theoretical innovations with sympathetic understanding, youthful enthusiasm, and mature judgment.

* * * *

Corrosion of Metals

A BIBLIOGRAPHY OF METALLIC CORROSION. By *W. H. J. Vernon*. Edward Arnold and Company, London. (Longmans, Green and Company, New York.) 341 pages. Price \$8.40.

Reviewed by JAMES A. LEE

THIS bibliography gives a "bird's-eye view" of the subject of metallic corrosion and represents a revision and enlargement of the bibliography prepared by the author under the auspices of the British Non-Ferrous Metals Research Association.

Considerable attention has been given to the classification, so that the relationship of the various branches of the subject may be readily traced. It includes over 3,800

references to work published prior to January, 1928. A great deal of cross-referencing was necessary. Under each heading the entries are made in chronological order except that papers published in any one year are grouped in alphabetical order of the authors' names. In many cases further information has been given in the form of abstracts or notes.

The book is divided into four sections: I—types of corrosion and factors influencing corrosion; II—nature of the corroding medium; III—nature of the metal; and IV—methods of protection. It contains a great deal of valuable information for those interested in studying and investigating corrosion. The one glaring omission is an index of authors, which is often a convenience in locating a particular article.

* * * *

Handbook of Materials

MATERIALS HANDBOOK. By *George S. Brady*. McGraw-Hill Book Company, Inc., 1929. 428 pages. Price, \$4.

TO CALL a smallish handbook "An Encyclopedia for Purchasing Agents, Engineers, Executives and Foremen" seems offhand a rather strained ambition, but a captious user will find disappointingly little to grumble at when he comes to resort to it. Materials covering a wide range of applications are alphabetically arranged and described. Within the prescribed limits, of course, there can be no learned scientific excursus, or last-minute market information either, on each material; but a skillful economy of words affords place not only for the information essential to its chosen audience but also for many desirable secondary data. This audience is then likely to be thankful that its informant is at least not encyclopedic in bulk.

* * * *

Recently Arrived

PULP AND PAPER INDUSTRY OF THE PACIFIC NORTHWEST. By *Henry Kreitzer Benson*. Published by the University of Washington, Seattle, as its Report No. 1. 1929. 89 pages. 75 cents.—Includes the technical proceedings of the pulp and paper conference held at the University of Washington Oct. 26, 1928. Those interested in conditions in these industries in the Northwestern States might find considerable information of both technologic and economic significance.

STEENKOOL: HAAR ONTSTAAN, VERVANGING EN VEREDLING. By *J. J. Bootsgezel*. A. E. Kluwer, Deventer, Netherlands. 437 pages. Price, 15 F.—An extensive treatise on coal processing; the material being more painlessly available in other languages, however, it seems somehow unnecessary to get in Dutch.

POLAR MOLECULES. By *P. Debye*. The Chemical Catalog Company, Inc., New York, 1929. 172 pages. Price, \$3.50.—Highly theoretical work on—well, polar molecules.

IDENTIFICATION AND PROPERTIES OF THE COMMON METALS AND NON-METALS. By *J. E. Belcher* and *J. C. Colbert*. The Century Publishing Company, New York, 1929. 246 pages. Price, \$1.75.—Students' manual of experiments, containing much auxiliary matter in the way of questionnaires and self-tests.

Proceedings of Sixteenth Annual Meeting of Compressed Gas Manufacturers Association. Published by the Association, 1929. 125 pages.—Gives the proceedings of the January, 1929, meeting of C.G.M.A., including the important technical committee reports on standards, tests, valves, and the various commodities produced by the association membership.

Selections from Recent Literature

FLAMMABLE LIQUIDS. Bruno Müller. *Chemiker-Zeitung*, April 17, p. 309. It is comparatively easy to protect flammable liquids from ignition by back-firing of a flame at the outlet of a pipe or container; but to prevent propagation of a flame or explosion once started within the pipe or container is much more difficult. The low heat capacity of a Davy safety gauze limits its effectiveness to a short period of time. The sandpot type of protector is safer, but it also fails under adverse conditions. A recent improvement, however, is to provide the sandpot protector with a small liquid trap, so that the sand is always wet with the liquid. This so increases the protective effect that no case of propagation of flame or explosion past the protector has yet been observed, even under the most adverse experimental conditions.

MULTI-STAGE DRYING. *Chemiker-Zeitung*, April 3, pp. 267-8. A recent major advance in drying machinery has been in improved application of the old principle of multi-stage drying, the greatest heat being used at first and the final drying being effected with a mild heat to prevent over-drying. This principle is useful for drying many chemicals and also for textiles, foods, soap, tobacco, casein and other products. Some recent constructions of multi-stage drying machines, with constant controlled air circulation, are described and illustrated.

RAPID DRIER. Otto Wolff. *Chemische Fabrik*, April 17, pp. 181-2. Steam driers, such as have long been used for substances not allowed to come in contact with flame or combustion gases, have not been efficient utilizers of heat energy. The introduction of mechanical ventilation improved their performance, but a large part of the saving was offset by the power required to operate the ventilator. The new Turbo system of multiple-chamber driers (up to 8 chambers) with forced circulation of steam and air has materially reduced the ratio of power consumption to steam savings. Its drying rate is rapid; a 2-chamber drier evaporated from a dye paste (76 per cent moisture) 128 lb. of water per hour, using 196 lb. of steam per hour. Over a wide range of materials and conditions the ratio of steam consumption to water evaporated varied from 1.5 to 2.3, using steam at 6 atm. pressure. Diagrams are shown.

SOAPY TRADE WASTES. C. H. Möllering. *Zeitschrift für angewandte Chemie*, April 27, pp. 424-7. Disposal of trade wastes containing soaps and emulsified fats is a problem in which both chemical and mechanical methods are useful and both may be needed. The commonest occurrences are the effluents from wool washing, silk mills and other textile processing plants. Chemical methods depend principally on acidifying the

soap, or precipitating it as a heavy metal soap, thereby breaking the emulsion of fats or fatty acids. The optimum conditions for such treatment must be found by trial for each case. The principal mechanical treatments are centrifuging and separation by foaming. The latter resembles the flotation process used in concentrating ores. Mechanical treatments remove at most about 60-70 per cent of the fat in the effluent. Chemical treatment may be more effective, but part of the fat often is in such fine suspension that it cannot be removed without unjustifiable expense. In some cases, especially in wool washing, the treated water is returned to the process for reuse.

PROTECTING CONCRETE. R. Grün. *Korrosion und Metallschutz*, April, pp. 73-84. Concrete structures suffer various kinds of destructive attack, according to their conditions of exposure—e.g., acid waters or acid forming gases (SO_2 , H_2S , CO_2), sulphates, ammonium salts, oil wastes, etc. Some hazards of exposure can be lessened by proper composition or by special modes of construction. For some conditions the concrete must be jacketed or a protective coating must be applied. Bituminous coatings are effective if protected from mechanical destruction, and are inexpensive. They must be tested at intervals, however, and renewed as needed. At least two coats must be applied. The first application is more important than later renewals, because it protects the concrete while it is fresh and most subject to attack. An accelerated testing method for coatings on concrete is described and illustrated. Test results from 31 different coatings are tabulated.

SUGAR REFINING COSTS. N. A. Helmer. *Sugar*, May, pp. 191-3. Methods of operation of centrifugal driers in sugar refineries can be chosen, by proper attention to engineering details, so as to effect considerable economy in drying. A common mistake is to carry the sucrose removal from the molasses beyond the point of optimum cost efficiency. The limit to which sucrose reduction is carried should be adjusted to prevailing conditions of centrifugal capacity, storage and tank-car facilities, power costs, etc. In general, electrical drive is preferable to belt drive, but there is no fixed rule in this respect.

AUTOGENOUS WELDING. Franz Mühlert. *Apparatebau*, May 3, pp. 103-4. Methane, which is now commercially available from several sources (natural gas, sewage sludge digestion, coal gas), is a useful welding gas where a comparatively low temperature is wanted. Noteworthy examples are in the autogenous welding of copper, brass, aluminum and lead. In the liquefaction process of preparing hydrogen (for ammonia synthesis) from coal gas, the methane fraction liquefies at -150 to

-200 deg. C. It is shipped in steel cylinders under 125 atm. pressure. This methane is free from harmful sulphur compounds and also from nitrogen, which, though not harmful, would be an undesirable diluent. The approximate heat values of the welding gases (in cal. per cubic meter) are: hydrogen, 2,600; methane, 8,500; acetylene, 13,500. The flame temperature of methane is somewhat lower than that of hydrogen, and its rate of combustion is slower, because methane requires 10 volumes of air to burn; hydrogen only 2. On account of its slow combustion, methane alone is not suitable for most welding work; it needs to be blended with hydrogen to the heat content and burning rate most effective for the work in hand. Thus, a mixture of equal volumes has a heat value of about 6,000 cal. per cubic meter and for working with lead it saves 48 per cent in fuel and 9 per cent in working time. For cutting iron and steel, a methane-hydrogen mixture in the ratio 37:63, heat value 5,260 cal. per cubic meter, saves 67 per cent in fuel, 19 per cent in time, and 25 per cent in oxygen requirement. With a properly blended gas very thin sheets of aluminum can be successfully welded. The mild methane flame is especially satisfactory when working with fluxes; they do not vaporize before they become effective.

HYDRO-EXTRACTORS. *Chemical Age*, May 4, pp. 423-4. The recent report of the International Labor Office of the League of Nations on safe construction and equipment of hydro-extractors considers these machines more hazardous than steam boilers. The principal danger, of course, is the bursting of the drum. The internal pressure generally is at least 3 kg. per square centimeter; there are no gages or warning signals, and the operators often are not specially trained. Bursting may result from overloading or from weakness due to wear or corrosion. Other hazards arise from improper operation and from failure of belts, pulleys or other accessory equipment. When corrosive or toxic liquids are being treated, the drums must be constructed or lined to withstand attack and remain liquid-tight. A chapter on safe design gives calculations of load, centrifugal force, power, and other desirable factors.

DECONCENTRATION. Technicus. *Chemical Age*, May 11, pp. 443-4; May 18, pp. 465-6. Even when softened or treated boiler water is used, progressive increase in content of dissolved solids ultimately requires attention. Steam purifiers can be used to prevent passage of salts into the steam; and deconcentrators of the continuous-pressure filter type may be installed, but are effective only against suspended matter. The usefulness of boiler compounds is limited largely to locomotive boilers and the like where other correctives are not applicable. The blow-down plan is effective, but involves heat losses. This objection can be overcome, however, by a continuous blow-down system which permits recovery of most of the heat

of the water, which is continuously discharged in small amounts from the boiler.

LIQUID TANKS. Adolf Barth. *Chemische Fabrik*, April 24, pp. 193-4. An improvement in tank and vat construction has been effected by combining wood and metal, instead of building all of wood or all of metal. Metal-bottomed tanks with wood sides or jackets can be built so as to overcome some of the structural defects of older constructions. They also make possible economies in construction and in heat utilization, the metal bottom being used as a heating plate. The wooden sides or jacket provide very efficient insulation against heat loss. Diagrams are shown.

FIRE EXTINGUISHING. Alfred Karsten. *Chemische Fabrik*, April 24, pp. 194-5. One of the newer methods of fire fighting which, like foam extinguishing, is superior to water in many cases is the use of carbon dioxide snow. When solid carbon dioxide is spread on a fire it extinguishes flame not only by its copious gas evolution but also by its great cooling effect in absorbing heat of vaporization. It has the further advantages of being harmless to materials and leaving no residue. It is particularly useful for electrical fires, where water is dangerous. It can be arranged, by use of fusible metal, for release of the gas pressure by the heat of a fire, so that, where conditions warrant, an installation can be used as an automatic extinguisher.

CORROSION PROTECTION. Wm. Moeller, Jr. *Gas Age-Record*, May 18, pp. 675-6. In applying a coal-tar or asphalt coating to a pipe line to prevent soil corrosion, the first essential is perfect bonding of coating to metal. The pipe must be thoroughly clean and dry, preferably sand-blasted. Pickling also gives a suitable surface, but requires careful drying and is not adaptable to field work. Mechanical brushing tends to leave the surface too smooth or not clean enough. The best practice is to have the pipe cleaned at the mill and covered with a priming coat, the kind depending on the coating to be finally applied. The pipe is then shipped and the final coat is applied where the line is laid. The quantity and kind of final coating should be adapted to the corrosive conditions to be encountered.

REDUCTION GEAR. *Industrial Chemist*, May, pp. 197-8. The Humfrey-Sandberg unidirectional clutch, in the form of an improved ratchet mechanism, has been successfully applied as a reduction gear on a feeding device for ebonite dust-air separators where it was desired to reduce the motor speed from 1,420 to 3.5. There are many possibilities for use of this type of apparatus in chemical plants—e.g., on worm or paddle feeds, conveyors, rotary furnaces, stokers, mixers, mixing autoclaves, slow-speed valve control, lime feeds for water softeners and so on. Diagrams and photographs are given, showing the unit and the device.

Agriculture Technical Bulletin 108. 10 cents.

Relative Ageing Properties of Gelatin Dynamites Containing Nitroglycerin and Ethylene Glycol Dinitrate, by A. B. Coates and G. St. J. Perrott. Bureau of Mines Serial 2923. Mimeographed.

The study of a Fundamental Basis for Controlling and Gauging Natural-Gas Wells. Results of a study by H. R. Pierce and E. L. Rawlins, issued in two parts as mimeographed Serials of the Bureau of Mines: Part I—Computing the Pressure at the Sand in a Gas Well, Serial 2929; and Part II—A Fundamental Relation for Gauging Gas-Well Capacities, Serial 2930.

The Effect of Substituting Ethylene Glycol Dinitrate in Permissible Explosives, by G. St. J. Perrott and J. E. Tiffany. Bureau of Mines Serial 2935. Mimeographed.

Losses of Phosphate in the Land-Pebble District of Florida, by H. M. Lawrence. Bureau of Mines Serial 2925. Mimeographed.

The Reduction of Cuprous Oxide by Carbon Monoxide, by Charles G. Maier. Bureau of Mines Serial 2926. Mimeographed.

Petroleum Refineries in the United States Jan. 1, 1929, by G. R. Hopkins and E. W. Cochrane. Bureau of Mines Information Circular 6116. Mimeographed.

Survey of Gravities of Domestic Crudes by G. R. Hopkins, and A. B. Coons. Bureau of Mines Information Circular 6114. Mimeographed.

Graphite. Four Bureau of Mines Information Circulars have been issued on this subject under the authorship of Paul M. Tyler, as follows: Part I—General Information, Circular 6118; Part II—Domestic and Foreign Deposits, Circular 6122; Part III—Utilization of Graphite, Circular 6123; and Part IV—Status of the American Graphite Industry, Circular 6124.

The American Chemical Industry—Production and Foreign Trade in First Quarter of Twentieth Century, by A. H. Swift. Bureau of Foreign and Domestic Commerce Trade Promotion Series 78. 20 cents.

Record Book of Business Statistics; Part III, Fuels, Automobiles, and Rubber. Pamphlet issued by the Bureau of the Census. 10 cents.

Summarized Data of Zinc Production, by Elmer W. Pehrson. Bureau of Mines Economic Paper No. 2. 15 cents.

Historical Summary of Gold, Silver, Copper, Lead, and Zinc Produced in California, 1848 to 1926, by James M. Hill. Bureau of Mines Economic Paper No. 3. 5 cents.

Mineral Production Statistics for 1928—preliminary mimeographed statements from Bureau of Mines on: Carbon Black, Lead and Zinc Pigments and Zinc Salts, Refined Primary Lead, Bauxite, Aluminum Salts, Potash, Iron, Aluminum, Chromite, Copper, Mercury, Platinum and Allied Metals, and Natural Masonry and Puzzolan Cements.

Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

German Superphosphate Industry, by Trade Commissioner William T. Daugherty. Berlin. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 272. Mimeographed.

Netherlands Building Nitrogen Plants, by Commercial Attaché Jesse F. Van Wickel, The Hague. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 271. Mimeographed.

Pyrites and Pyrites Cinders in Italy, by Consul Homer Brett, Milan, Italy. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 274. Mimeographed.

Sulphur and Sulphuric Acid Market in Porto Rico, by Assistant Trade Commissioner J. R. McKey, San Juan, Porto Rico. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 270. Mimeographed.

Canadian Market for Solvents, by Assistant Trade Commissioner A. H. Thiemann, Ottawa, and others. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 248. Mimeographed.

The Marketing of Antimony, by J. W. Furness. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 624. 10 cents.

General Index of Summary of Tariff Information, 1929, on The Tariff Act of 1922. Issued by the Tariff Commission. 10 cents.

Carburetion of Combustible Gas With Butane and Propane-Butane Mixtures, With particular Reference to the Carburetion of Water Gas, by William W. Odell. Bureau of Mines Bulletin 294. 25 cents.

A study of the Crude Oil produced in the Salt Creek Field, Wyoming, by H. P. Rue and I. N. Beall. Bureau of Mines Technical Paper 449. 5 cents.

Petroleum Refineries in Foreign Countries, 1929, compiled by Robert E. Taylor. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 623. 10 cents.

Stiffness in Fabrics produced by Different Starches and Starch Mixtures, and a Quantitative Method for Evaluating Stiffness, by Esther C. Peterson and Tobias Dantzig. U. S. Department of

THE PLANT NOTEBOOK

an exchange for OPERATING MEN

Electrical Equipment in the Chemical Plant

By W. E. WARNER
Brentford, England

CORROSIVE atmospheres about the chemical plant are responsible for a number of difficult problems in connection with electric motors and their starting equipment. The fumes and gases tend to attack the insulation on the various insulated parts and to cause the bare metallic surfaces to corrode.

The most suitable motors for this work are undoubtedly the totally inclosed, ventilated motors in which the ventilating air is continuously circulated from the outside of the building by means of a fan. Inclosed motors which are not ventilated are not satisfactory for fumes, and vapors work into the motors and condense. When the motor is not ventilated properly, the corrosive materials remain in the motor. Open-type motors in which the air has free access to the motor rarely give satisfaction in decidedly corrosive atmospheres although they sometimes are used with success under milder conditions.

A damp, warm atmosphere is particularly conducive to chemical action. Oil which collects inside the motor will absorb acid from the atmosphere and be rendered corrosive itself, thus corroding any metal work and deteriorating the insulation. In time a corrosive deposit will form on both field and armature coils. This calls for repeated cleaning with a dry cloth at intervals of, say, twice a week. If this deposit is allowed to remain it will react with the insulation.

The coils should be kept well varnished with some such material as shellac. If the atmosphere is very corrosive, an outside coat of some acid-proof paint is desirable for additional protection.

A great deal of trouble often is caused by the air which is drawn into the armature through the commutator risers as the motor rotates. If the air is corrosive, a deposit will be formed inside the armature and behind the commutator and will in time eat away the insulation.

The easiest way to prevent this is to block up the spaces between the risers and prevent air from being drawn into the armature. This may be done with muslin intertwined between the riser bars. This will hinder ventilation, however, and cause a higher operating temperature. The temperature should be watched and, if necessary, the load must be reduced.

Cowls have sometimes been fitted to prevent air being drawn into the armature. The brush pigtails are an-

other part likely to be attacked. The flexible copper leads are easily corroded and the most effective remedy is to tin the conductors. Where leads are connected to terminals, the safest plan is to tighten up the connection and then give it a coat of shellac.

In some atmospheres commutators tend to blacken very quickly. The remedy for this is frequent cleaning, and if the micas are recessed these should be frequently cleaned out. The starting equipment also requires protection, particularly the bare metallic surfaces on the resistance coils. This equipment should be inclosed, connections should be made very carefully and the front contacts should receive frequent cleaning and inspection.

Eliminating a Shortage of Compressed Air

By F. M. AHR
Dayton, Ohio

MANY PLANTS find upon expansion that their compressed air supply is inadequate and that there is a demand for additional compressors. Often the purchase of greater compressor capacity can be avoided by a careful survey of all departments of the plant, determining the consumption with a view to conservation. Compressed air is easily wasted, and unconsciously too, so that very close scrutiny is necessary to maintain pressures. Even then in spite of all economies, the demand for air may run close to the limit of capacity and the purchase of additional compressors become apparently unavoidable.

Such a condition arose in a very large plant having three Ingersoll-Rand compound compressors running at 175 r.p.m. and maintaining 100-lb. pressure. Just about the time it was decided to purchase another cross-compound compressor, a survey was suggested as to the pressures required around the plant. It was strange to find that about 75 per cent of the air used required less than 30-lb. pressure. Such uses included salt ejectors, agitators, pneumatic temperature and pressure control systems and so on.

It was known that the low-pressure cylinder could maintain a 30-lb. pressure alone, without the use of the second stage of compression. After consulting the manufacturers it was decided to change the high-pressure cylinder to the same size and type as the low-pressure cylinder, and operate the two cylinders individually, both taking air from the atmosphere and discharging into the same low-pressure receiver. This doubled the capacity of the compressor. The change was made on two

of the compressors, with the necessary changes in piping and receiver tanks. The remaining high-pressure compressor was connected into a separate tank and lines to it were reconnected.

We had no further trouble with air shortage and really obtained much better operating conditions than before on the processes requiring lower-pressure air because we avoided the use of throttling valves and pressure reducers.

Improving "Slide-Rule Accuracy"

EVERY engineer who has much use for a slide rule has evolved some method for keeping track of the decimal points, only to find that the system is likely to fall down at a critical juncture. William J. Alcott, Jr., writing recently in *Engineering News-Record*, gives a system of "one-place" logarithms which the writer says not only fixes the decimal point in complicated calculations but also provides a rough check on the accuracy of the slide-rule computation.

The mantissas given are as follows:

Number	Memory Mantissa	Two-Place Mantissa
1.3	0.1	0.11
1.6	0.2	0.20
2	0.3	0.30
3	0.5	0.48
4	0.6	0.60
5	0.7	0.70
6	0.8	0.78
7	0.85	0.85
8	0.9	0.90
9	0.95	0.95
10	1.0	1.00

A brief glance at a log table will convince the reader of their accuracy. For use, the "memory mantissas" should be memorized according to the following scheme: The mantissas 0.1 and 0.2 correspond to the numbers 1.3 and 1.6 which are spaced approximately evenly between the numbers 1 and 2. The mantissa for 2 is 0.3. Then for numbers 3 through 6, the mantissas are two more than the number—that is, for 3, 0.5; for 4, 0.6; for 5, 0.7; and for 6, 0.8. Then for the numbers 7 through 9, the mantissas increase by steps of half-tenths; thus the mantissa for 7 is 0.85; for 8 is 0.90 and for 9 is 0.95.

The column of mantissas for two places is added for comparison, although for purposes of rough check and pointing off, it is not necessary to memorize its variations from the single-place figures.

The "one-place" logarithms are used just as ordinary log tables are used. That is, when each is assigned its proper characteristic, it may be added or subtracted, multiplied or divided. The result will give the number of decimal places accurately, while the slide rule is used to obtain the significant figures.

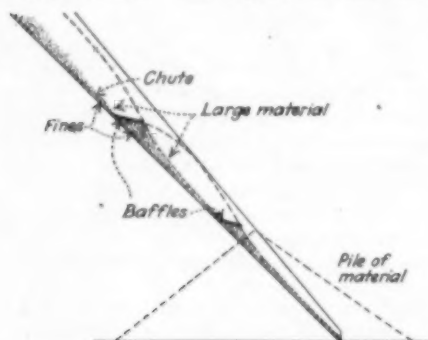
EQUIPMENT NEWS

from MAKER and USER

Novel Bin System

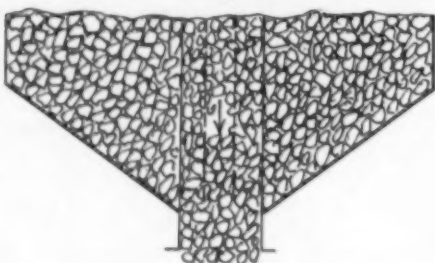
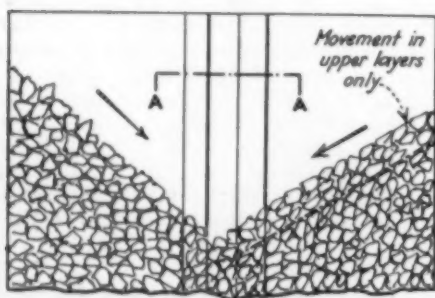
THE Adams process, which is being handled by Eaton-Kent, Inc., 17 Academy St., Newark, N. J., is a system designed for filling and emptying bins of coke and coal with reduced degradation and stratification of the material. It may also be used with other lump materials where these features are desirable.

The system, in general, consists of two parts: a feed chute and a withdrawal chute. The object of the feed



Adams Process "Avalanche" Chute for Filling Bins

chute is not only to reduce breakage of the material but to reduce wear in the chute. This is accomplished by placing a number of baffles in the chute at such angles that the fines will gradually collect above them, as shown in the



Adams Process Withdrawal Chute Showing Movement of Coke Only in Upper Layers

drawing, forming a cushion between the lumps and the chute and preventing wear to a large extent.

The second feature of the system, the withdrawal chute, is said to be even more effective in reducing degradation of the coke or other material. This is shown in the second drawing to consist of a vertical tube, square in cross-section and open the entire length of one side. This is placed in the bin with the bottom at the discharge. It is pointed out that in the ordinary system of withdrawing directly from the bin a considerable portion of the body of coke moves toward the discharge when the coke is being withdrawn, resulting in grinding of adjacent pieces of coke and consequent degradation. With the Adams system the coke adjacent to the opening in the side of the tube forms a light bridge except at the top where material rolls quietly into the opening and descends in the form of a solid column to the discharge.

It is further pointed out that stratification takes place in filling a bin by reason of the tendency of the larger lumps to roll the greater distance. When the bin is being emptied by the Adams system the reverse effect takes place, with the lumps carrying the fines into the discharge in the proper proportion, so that the material is reassembled in a completely mixed condition.

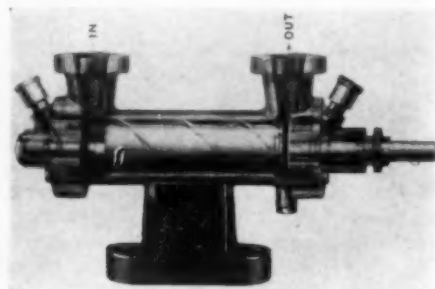
New Rotary Pump

AN INNOVATION in rotary pumps appears in a new screw type recently introduced into this country from France. It is being distributed in this country by the S.A.M. Pump Corporation, of 11 West 42nd St., New York.

In contradistinction to the usual type of two-screw pump, the S.A.M. has only one screw. This consists of a number of disks mounted centrally on a single shaft which is, in turn, located eccentrically in a cylindrical bore. In each disk there are two diametrically opposed slots which hold loosely fitted straight blades. When assembled in the pump the blades closely approximate a double screw thread.

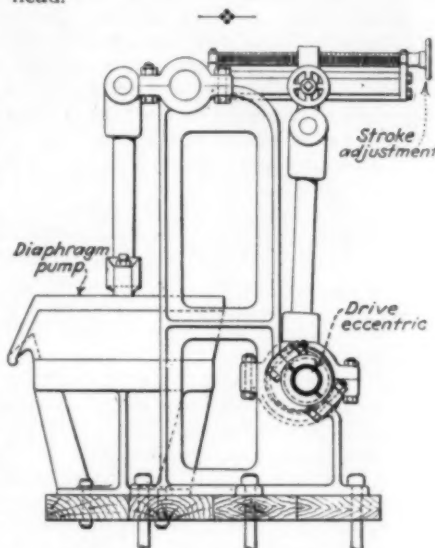
When the shaft is made to rotate the blades are held against the cylinder wall by centrifugal force and tend to compel the liquid to rotate with them about the axis. However, as the rotor is tangent to the cylinder at one side, rotation of the liquid is impossible and it is then forced along the cylinder in straight stream lines parallel to the axis and at constant velocity. The phantom view given herewith makes this clear.

Among the features claimed for the pump are its pulsationless character, its self-priming feature and the fact that



Phantom View Showing Principle of S. A. M. Pump

it may be very simply repaired in case of wear. It is to be noted that the blades are self-adjusting for wear. It is said that the pump is intended for any liquid regardless of viscosity and will draw 29 in. of vacuum on closed suction. It is made in sizes of from 5 to 48 gallons of water per minute against 130 ft. total head.



Hardinge Sludge Pump With Variable Stroke

Variable Sludge Pump

RECENTLY the Hardinge Company, York, Pa., announced a new diaphragm pump for handling slurries, particularly in connection with continuous settling tanks and thickeners. The principal feature is a variable stroke which may be adjusted without stopping the pump. The drawing clearly illustrates how this is accomplished. The pump is driven from a fixed-throw eccentric through a walking beam, one arm of which may be varied in length by means of a screw adjustment while the pump is in operation.

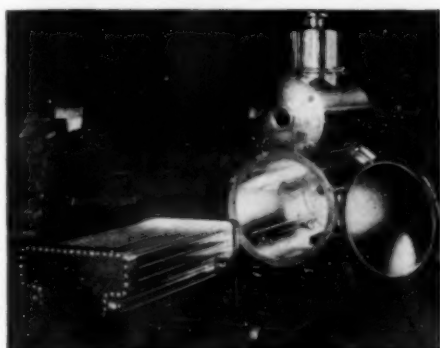
The diaphragm pump consists of the usual type of body with an easily replaceable diaphragm, flat valves and rubber valve seats. The pump is made

in single, double and triple arrangement and may be supplied with individual motor drive or belt connection. It is furnished for either 3-in. or 4-in. suction pipe. Capacities in tons of solids per 24 hours for a 50 per cent solids sludge vary between 85 tons for a 3-in. simplex to 435 tons for a 4-in. triplex pump.

Removable-Tube Evaporator

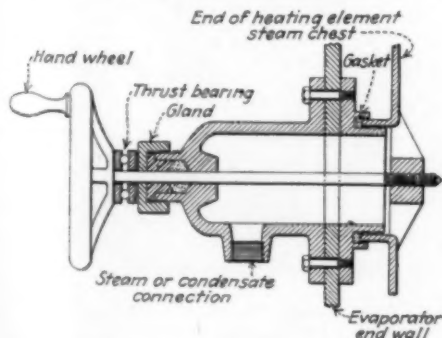
FOR evaporation processes where ease of cleaning of the tubes is especially important a new evaporator has been developed by G. A. Zeitler and is being made by the Oakland Copper & Brass Works, Oakland, Calif.

An accompanying photograph shows the evaporator to consist of four principal parts, the removable tube body, the evaporator body or boiling chamber,



Zeitler Evaporator With Tube Bundle Withdrawn

a vapor chamber placed above the evaporator body and a catchall at the top of the vapor chamber. It will be noted that the tube bundle is mounted upon rollers on which it may be rolled from tracks within the evaporator body to a carriage which in turn may be withdrawn upon a track in front of the evaporator. The drawing shows how the tube bundle is attached to the steam and condensate connections in the far



Device Used to Secure Steam and Condensate Headers to Respective Connections

head of the evaporator body. The bundle may be quickly withdrawn and removed for cleaning.

The vapor chamber is slightly smaller in diameter than the evaporator chamber and connects with it for its entire length. The catchall, placed on top of the vapor chamber, is merely a dome to which the

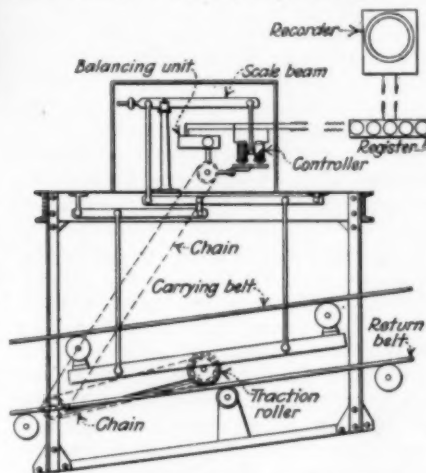
vapor line to the condenser is connected. The machine is available in various sizes and in metals for any type of service.

Evaporation of scale-forming solutions and the production of boiler feed water are believed to be the principal fields for the new evaporator.

Automatic Continuous Scale

A NEW automatic scale for continuously weighing material in transit on belt conveyors has recently been developed by John Chatillon & Sons, 89 Cliff St., New York, N. Y., and is known as the "Telepoise."

The machine consists of a steel framework the lower part of which, as is shown in the drawing, includes a traction roller riding on the return belt and a floating section of belt carriers for the carrying belt, connected with the weighing mechanism. The weighing mechanism consists of a scale beam balanced by means of calibrated springs. Beneath the end of the beam is the integrating mechanism which electrically translates the position of the scale into impulses which are recorded on a register or recorder. The position of the scale beam, of course, depends upon the



Elevation of "Telepoise" Conveyor Scale Mechanism

instantaneous weight of material on the carrying belt.

The portion of the instrument which sends out the electrical impulses is known as the controller and consists of two drums driven in opposite directions at a speed proportional to that of the belt by means of the traction roller. The left-hand drum is ribbed vertically while the right-hand drum has a smooth surface which is half metallic and half insulating. The dividing line between the conducting and insulating surfaces is part of a helix so that the surfaces are like two equal right-angle triangles wrapped around a cylinder and fitting together along the hypotenuse. As the drum rotates, a brush which is in contact with the left drum is caused to vibrate between the drums. Its vertical position between the drums determines its duration of electrical contact with

the right-hand drum and hence the number of electrical impulses caused by the ribs of the left-hand drum during one revolution.

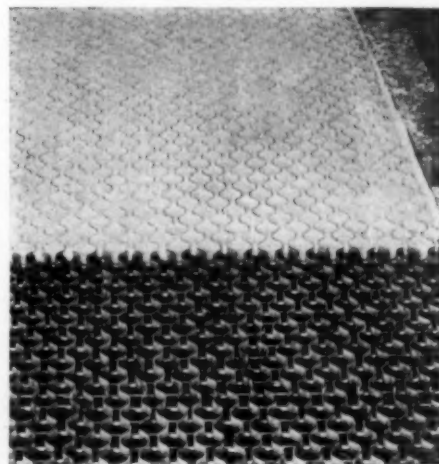
It is evident that the number of contacts per foot of belt travel depends directly upon the weight being carried. In order to balance the instrument a shift lever is used to transfer a small weight to the weigh beam and automatically cut out the load register. The controller is simultaneously connected electrically to the balancing unit, which is so adjusted that it will indicate immediately whether or not the system is in balance, and if not, what adjustment to make.

Armored Gasket

An improvement in its standard "Flexitallic" gasket has been announced by the Flexitallic Gasket Company, Camden, N. J. This consists of a one-piece metallic armor which is spun around the gasket. The covering is of thin sheet aluminum and is said to conform well to irregularities in the flanges and make a tight joint. The new gaskets are available in sizes from 1 in. to 20 in., i.p.s., and for pressures up to 1,300 lb. per square inch.

Steel-Armored Floor

A PRODUCT called "Floorgard" is announced by Blaw-Knox Company, of Pittsburgh. As is clearly shown in the illustration, this consists of a continuous steel mat which is laid down upon the surface of the floor. The interstices are then filled in with asphalt, concrete, or other composition material, giving a level floor which, it is said, will not wear down below the surface of the steel reinforcing. The design is such that there are no acute angles for the formation of thin, easily broken fins of concrete.



Showing Finished and Unfinished Sections of "Floorgard"

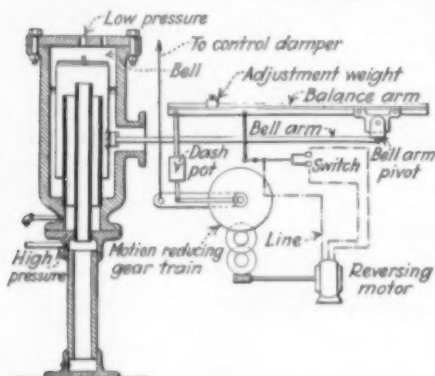
Crawler Barrow

The influence of the tractor age has recently made itself felt upon the wheelbarrow. The Isbell-Porter Company, Newark, N. J., has developed a wheel-

barrow which, like the crawler tractor, lays its own tracks as it goes. The manufacturer suggests that there are many places around the chemical plant where a wheelbarrow equipped with crawler tread will assist in handling materials over uneven ground.

Volume-Flow Regulator

A NEW volume-flow regulator has been developed by the Brooke Engineering Company, 1321 Arch St., Philadelphia, Pa., primarily for maintaining a constant volume flow of air and ammonia gas for the synthesis of nitric acid. The machine was designed for an initial pressure of 100 lb., with a maximum allowable variation of 2 per cent. Those which have been used to date are set to maintain a differential across



Schematic Drawing of Brooke Flow Controller

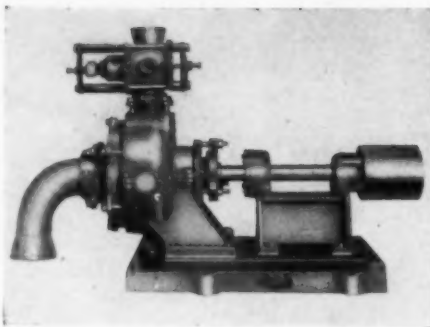
an orifice of 6 in. of water column with a total allowable variation of not over 0.2 in., plus or minus.

The accompanying drawing shows the regulator schematically. It consists essentially of a heavy casting containing a bell in an oil seal. The vertical movement of the bell is mechanically magnified by means of a long arm pivoted at the right. The shaft extends from this pivot through a stuffing box and is connected to the balance arm, which is calibrated in units of 0.1 in. of water.

Movement of the balance arm is communicated to a set of electrical contacts which cause a small universal motor to run either forward or backward. The motor drives through a very high reduction train an operating arm which is connected to the valve or damper to be controlled. Compensation is provided by an oil dashpot. Movement of the small sliding weight placed on the balance arm permits immediate change from one operating differential to another.

Stoneware Centrifugal Pump

TWO NEW stoneware pumps for use with practically any chemical except hydrofluoric acid have recently been introduced by the U. S. Stoneware Company, Akron, Ohio. Pump No. 1 has a capacity of 290 g.p.m. and pump No. 2 a capacity of 575 g.p.m. at 750 r.p.m. The pumps are identical in con-



Open-Impeller Chemical Stoneware Pump

struction except in the matter of size. The illustration will serve for both.

All parts of the pump coming in contact with the material handled consist of acid-proof chemical stoneware guarded and reinforced by means of metal parts. The casing consists of a solid shell type of housing which is open at the front for the removal of the impeller. It is inclosed by means of a stoneware cover having the inlet opening in the center. The housing is mounted in a cast-iron protecting casing which supports it at three points. Another casting protects and holds the front stoneware cover in place. Attached to the second casting by means of bolts which may be drawn up tight is a ring for holding the suction elbow in place.

The impeller is made in the open front form intended to pass solids in suspension without clogging. It is made of stoneware cast over a metal bushing into which the steel pump shaft is screwed. A stoneware sleeve is slipped over the shaft and run through the stuffing box while a stoneware nut is screwed on the suction end of the impeller. This insures complete protection of the metal of the shaft.

Other features of the pump include two ball bearings for mounting the shaft, a deep stuffing box, and a stoneware gland. Each pump also is provided with a three-way priming cock of the tapered-plug type made of chemical stoneware. Pumps may be furnished for direct connection to a motor or may be provided with a pulley. The motor base is of cast-iron and may be supplied long enough to mount the motor directly. The performance of the pump is said to be approximately equal to all-metal pumps.

Three-Roll Paste Mill

The J. H. Day Company, of Cincinnati, Ohio, has recently brought out an improved form of three-roll grinding mill suitable for inks, pigments, varnish colors, chemical precipitates and similar paste materials. The mills making up the line are built in five sizes, classified by roll sizes, ranging from 5x12 in. to 16x40 in. The mills are of unit construction with motor and necessary reduction gears integrally mounted. Main shafts and rolls are equipped with Timken bearings. The features of the mill include a simple adjustment for fineness, ease in cleaning and a safety feature at the feed end of the mill.

Pressure Thickener

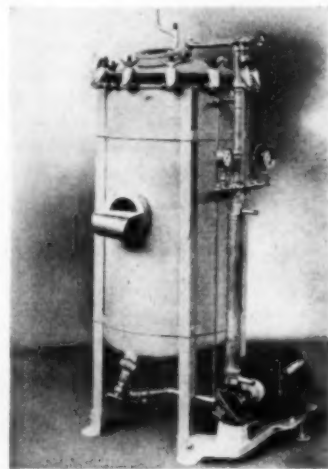
A CHANGE that can be made in its standard rotary filter has recently been announced by the Vallez Filter Division of the Goslin-Birmingham Corporation, Birmingham, Ala. Through a simple addition to the filter, consisting of stationary knives placed between the rotary leaves of the machine, it is possible to thicken pulp continuously to any desired density.

The machine used is of the clarifying type which has added to it double knives supported a short distance from each filtering surface by attachment to the main shaft and an auxiliary shaft placed slightly above the bottom of the machine in the direction of rotation. As the leaves rotate toward the knives the cake, after it is built up to a distance corresponding to the clearance, is continuously cut off and settled to the discharge. It is pointed out that the action of this thickener is independent of gravity settling and that it is positive and under valve control at all times. As it operates under pressure in contradistinction to other types of filter thickeners, it is believed to open up new fields for this type of apparatus.

Glass-Lined Percolator

A NEW 50-gal. percolator, recently introduced by the Pfaudler Company, of Rochester, N. Y., is known as the "Pre-Vak, Jr." This is a redesign of a 60-gal. percolator which sold at more than double the price of the new one.

The new percolator consists of a glass-lined receptacle provided with a pressure-tight cover which is capable of being swung away from the body of the percolator on a pivoted arm. Material



New 50-gal. Pfaudler Percolator Operating on Pressure-Vacuum System

to be treated is placed in a metal basket with a perforated bottom which is suspended within the receptacle so that a pressure-tight joint is formed between the regions above and below the basket. A circulating system withdraws the extracting liquid from the bottom of the receptacle, passes it through a rotary pump and up through a pipe, which may or may not be provided with a steam

jacket for heating, and then to a spray located in the cover of the percolator.

Sight glasses are set into the cover and side of the percolator. Other features include a mounting for the pump motor attached directly to the apparatus, a relief valve for bypassing the menstruum in case of overpressure and a three-way valve mounted in the circulating line for discharge of the extract from the percolator to storage.

The machine is intended for performing pharmaceutical percolations and for the making of other extracts. In operation the material to be extracted is sprayed with the extraction liquid while the region above the basket is under a pressure of about 8 lb. This combined with a vacuum maintained at about 4 in. beneath the basket causes the liquid to pass rapidly through the material. Menstruum may be either heated or run cool as required.



New Lincoln Water-Cooled Carbon Electrode Holder

Carbon Electrode Holder

A RECENT ANNOUNCEMENT from the Lincoln Electric Company, Cleveland, Ohio, describes a new type water-cooled carbon electrode holder intended for heavy-duty manual welding by the carbon arc process.

The new holder is known as type W and is said to be very light, weighing only 3½ lb. Two pieces of hose carry the cooling water to the holder, which consists of coiled copper tubing through which the water constantly circulates. The leads to the holder are cooled by being run through the pieces of hose, thus permitting the use of much lighter cable than would otherwise be necessary. The new holders are made in sizes for use with ¼-in., 5/16-in., ¾-in. and 1-in. carbons and are said to be very economical in electrode consumption.

New Control Pyrometer

WHEREAS most electric pyrometer controllers make use of open contacts and require a relay for controlling electrical loads of any magnitude, the new instrument made by the Republic Flow Meters Company, 2240 Diversey Pkwy., Chicago, Ill., and recently announced, incorporates a mercury switch. The switch is capable of carrying current up to 10 amp. and may, for instance, be used in controlling electric furnaces up to 3½ kw. capacity.

The accompanying sketch illustrates

the switch mechanism of the controller. A thermocouple is used to operate a millivoltmeter movement in the instrument. When the needle corresponds with the control point, which is set on the indicating dial by means of a target, the depressor mechanism, operated by a small synchronous motor is not permitted to descend on its periodic depression.

When the temperature is below the control setting, however, the depressor passes the pointer on its downward stroke and sets the crank arm, shown at the right, so that it turns the switch to the "on" position. The switch then remains in this position until the temperature rises and the pointer again intercepts the depressor, preventing it from completing the downward stroke. The crank arm then takes a different position and operates the trip lever which throws the switch to the "off" position. Hence the millivoltmeter is not required to do any work other than to move the very light pointer, while the position of the pointer causes the synchronous motor to trip the switch. The switch consists of a mercury contactor in which the contact is from mercury to mercury.

The instrument is provided with automatic cold junction compensation and is available with various scales up to 3,000 deg. F. It may be used with either noble or base metal couples, depending upon the temperature range.

Bronze Welding Rod

The Oxweld Acetylene Company, 30 East 42nd St., New York, has just placed upon the market a new and improved welding rod for bronze, known as Oxweld No. 21. This is recommended for all bronze welding applications, including the fusion welding of bronze and the bronze welding of other metals. The new rod is said to give a weld of extremely high strength, showing a tensile strength of over 45,000 lb. per square inch, which is claimed to be more than 30 per cent in excess of the strength obtainable with earlier bronze welding rods.

Non-Metallic Pipe

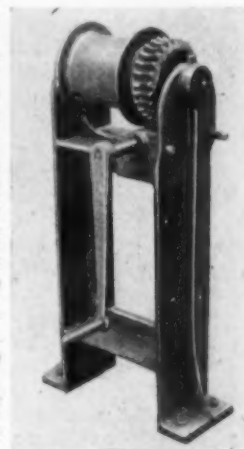
A SEAMLESS pipe made of asbestos and cement has been made for a number of years in Europe and is now being introduced into this country by the Johns-Manville Corporation, 292

Madison Avenue, New York. The pipe is manufactured in five general classes, one class of light weight, designed for sewer piping and exhaust stacks, and four pressure classes to carry liquids at working pressures of from 40 to 225 lb. per square inch.

The material is said to have a dense, close-grained structure which is readily cut, tapped and threaded with ordinary tools. Its weight is from 50 to 65 per cent less than cast-iron or steel pipe and it is said to have about 14 per cent greater delivery capacity than has new cast-iron or steel pipe. It is pointed out that the absence of corrosion will insure the continuance of this high delivery. The pipe is to be made in sizes from 2 in. to 40 in. in diameter and is recommended for gas, hot and cold water, brine and various corrosive liquids. The company is to install machinery for the production of 2,000,000 ft. of pipe per year.

Hand-Operated Winch

A new floor type, hand-operated winch has recently been added to the line made by Stephens-Adamson Manufacturing Company of Aurora, Ill. This winch, shown in the accompanying view, is built of cast iron and is actuated by a self-locking worm gear. The rope pull is 750 lb. at the drum. The drum has a capacity of 100 ft. of ¼-in. cable and 60 ft. of ⅜-in. cable. The hoist is said to be light and readily portable.



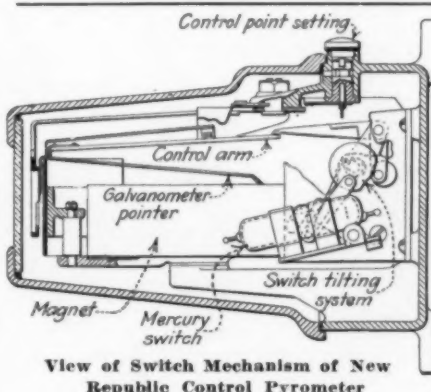
Floor Type Winch

New Lighting Fixture

To facilitate frequent and thorough cleaning of lighting fixtures at a minimum labor cost the Benjamin Electric Manufacturing Company, Des Plaines, Ill., has developed the new type 79 Glassteel Diffuser. The new unit consists of two parts, a permanent wiring base and another part comprising reflector, lamp and glass inclosing globe. The latter unit is secured to the terminal base by means of a bayonet lock which not only holds the reflector in position, but makes the electrical contact. Ease of cleaning on account of this detachable feature is the principal claim to novelty of the new device.

Steel Skid Platforms

Lewis-Shepard Company, Watertown Station, Boston, Mass., is now building a new type of skid platform of corrugated steel construction pressed from a single sheet of steel. The corrugations



provide rigidity and act as supporting girders to prevent the platforms from sagging. The platforms are available in sizes from 24x24 in. to 48x78 in. They are suggested particularly for use in the ceramic industries.

Protective Paints

The Joseph Dixon Crucible Company, Jersey City, N. J., announces the recent addition of two new paints to its line. One known as Dixon's Utility Paint is intended for protection at a lesser cost. The second paint is called Dixon's Maintenance Floor Paint and is made for protection of flooring of all kinds, including concrete.

New Electrical Apparatus

GENERAL Electric Company announces the development of new pieces of equipment including a new speed controller for slip-ring induction motors, primarily intended for the control of motors driving ventilating fans in buildings. This new device, bearing the designation CR-7765-B-1, has the primary magnetic switch, dial-type controller and speed-regulating resistance mounted in a sheet-steel inclosing case. It provides overload and undervoltage protection, and will give approximately 50 per cent speed reduction by inserting resistance in the motor circuit.

A second development is an electric strip heater which may be applied either as an air heater or as a "clamp-on" device. It is designed for general purposes where electric heat is required, and is suggested for use in valve houses, pump houses, process machines, drying ovens, compound tanks and so on. The device is 24 in. long, 1½ in. wide and ¾ in. thick. It is rated 500 watts at 110 or 220 volts. Slots are provided in each end allowing the heater to be supported in air or clamped to a metal surface. The current-carrying element is the usual nickel-chromium resistor, insulated from the sheath by magnesium oxide powder which is compressed into a compact mass by a 250-ton press.

A third device meets the demand for a hand-starting compensator for use in places where there are explosive gases or gasoline fumes. This bears the designation CR-1034-N-52 and is a modification of standard equipment designed to eliminate any exposed arcing. The starting switch is oil-immersed. The usual push-button tripping device is not employed but, instead, a standard time-delay undervoltage attachment and dashpot relays are used with Cooper Hewitt mercury tubes substituted for the usual contact tips of the dashpot relays. As a result of this arrangement, exposed sparking or arcing at contacts is eliminated.

Gasoline Locomotive

A new line of gasoline-powered, gear-driven industrial locomotives known as series 1.200 is announced by the locomotive division of the Cincinnati Car

Corporation, Cincinnati, Ohio. The line features the use of four starting and traveling speeds both forward and backward, liberal engine power, a special form of clutch and a power take-off for any auxiliary use such as a winch or hoist. Models are available for various track gages and in various sizes for hauling both industrial and railroad cars.

Longer Cast-Iron Pipe

The United States Cast Iron Pipe & Foundry Company, of Burlington, N. J., announces that De Lavaud centrifugal cast-iron pipe in all diameters from 4 to 12 in., inclusive, will now be available in 18-ft. lengths. Until this time the greatest length obtainable in centrifugal cast-iron pipe has been 12 ft. and in sand-cast pipe, 16 ft. It is claimed that the reduction in the number of joints required resulting from the use of 18-ft. lengths will prove of considerable advantage.

Manufacturers' Latest Publications

Blowers. The P. H. & F. M. Roots Company, Connersville, Ind.—Bulletin 22-B1—concerns low-pressure, rotary, positive blowers in all sizes for pressures of 2½ lb. or less.

Buildings. The Master Builders Company, 7016 Euclid Ave., Cleveland, Ohio.—"Omicron, The Fifth Ingredient," describes a new hardener for concrete; also bulletin entitled "Reducing the Ratio of Soluble Constituents in Portland Cement Concrete."

Burners. Lee B. Mettler Company, 406 South Main St., Los Angeles, Calif.—"The Challenge to Waste," catalog describing the Mettler entrained-combustion gas burners.

Combustion. American Engineering Company, Philadelphia, Pa.—"Completely descriptive of the Taylor stoker."

Cores. The Brown Company, Portland, Maine—Describes Bermico fiber cores and metal ends for paper mills.

Disintegration. Williams Patent Crusher & Pulverizer Company, 2701 North Broadway, St. Louis, Mo.—Catalog No. 381—describes the complete line of crushers, grinders and shredders made by this company.

Ejectors. The Elliott Company, Jeanette, Pa.—Bulletin G-1—describes single and multi-jet steam jet ejectors for use in petroleum refining, etc.

Electrical Equipment. Crouse-Hinds Company, Syracuse, N. Y.—Bulletin 2130—"Sunbeams in the Night," booklet on floodlighting.

Electrical Equipment. General Electric Company, Schenectady, N. Y.—Publications as follows: GEK-52 "Measured Performance, The First Step in Cost Control," describing GE recording meters; GEA-42A, induction power-directional relays; GEA-138A, current-limiting resistor; GEA-163B, automatic switching equipment; GEA-214A, Helicord sheath wire immersion heaters; GEA-334A, gearless traction elevator motors; GEA-881B, type WD-200A arc welder; GEA-940A, switchboard devices; GEA-994A, travel carriage for automatic arc welder; GEA-1021A, oil circuit breakers; GEA-1029A, outdoor switching equipment; GEA-1066A, centrifugal air compressors; GEA-1096, indoor disconnecting switches; GEA-1109, automatic sectionalizing switches; GEA-1118, two-stage reciprocating air compressors; GEA-119, reciprocating air compressor sets, single-stage; GEA-1120, reciprocating air compressor sets, two-stage; GEA-1121, portable single-stage reciprocating air compressor sets.

Electrical Equipment. The Lincoln Electric Company, Cleveland, Ohio.—Folder G-6—describes Lincoln safety push button.

Electrical Equipment. Roller-Smith Company, 233 Broadway, New York, N. Y.—Bulletin 600—describes new oil circuit breakers, type O.

Electrical Equipment. U. S. Electrical Manufacturing Company, 200 East Slauson Ave., Los Angeles, Calif.—Form 576—describes Auto Start self-starting squirrel-cage motors.

Electrical Equipment. Wagner Electric Corporation, St. Louis, Mo.—Bulletin 151—describes air-jacketed motors of dust- and fume-proof construction.

Equipment. Grisco-Russell Company, 285 Madison Ave., New York, N. Y.—Bulletin 1651—"Heat Transfer Apparatus," describing shell and tube types for refineries and gasoline plants.

Equipment. Struthers-Wells, Company, Warren, Pa.—Publications as follows: Circular 41, rotary driers; circular 42, IHV evaporators; circular 43, process equipment of non-corrosive and heat resisting steels; circular 44, heat exchangers.

Equipment. H. O. Swoboda, Inc., Pittsburgh, Pa.—Bulletin No. 160—complete description of "Falcon" electrically-heated, large asphaltum coating tanks.

Equipment. Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa.—Bulletin L20408, class 13-100 non-reversing magnetic starter for wound rotor induction motors. Bulletin L20401, type AD mechanical-drive turbines.

Evaporators. Swenson Evaporator Company, Harvey, Ill.—Bulletin S-128, the Swenson forced-circulation evaporator; catalog E-127, complete catalog of evaporators made by this company.

Fans and Blowers. Bayley Blower Company, Milwaukee, Wis.—Publications as follows: Bulletin B, Planing Mill Exhaust Fans; catalog 32, complete data on "Aerovane" blowers; leaflet on "Plexiform" fans.

Filters. T. Shriver & Company, Harrison, N. J.—Catalog No. 29—General catalog of filter presses, also press accessories including paper, cloth, diaphragm pumps and press plates and frames.

Filters. Philipp Wirth, 31 Union Square, New York, N. Y.—Bulletins descriptive of Seltz filters for pharmaceutical, bacteriological and chemical purposes.

Fire Protection. Chicago Bridge & Iron Works, 37 West Van Buren St., Chicago, Ill.—Catalog describes the use of Horton tanks in connection with fire protection.

Gas Engines. Chicago Pneumatic Tool Company, 6 East 44th St., New York, N. Y.—Bulletin 782—complete details on a new line of vertical gas engines.

Heaters. Bayley Blower Company, Milwaukee, Wis.—Folder on "Chinookfin" heaters with tables of data.

Instruments. Brown Instrument Company, Philadelphia, Pa.—Catalog 65—describes indicating and recording thermometers for temperatures—40 deg. to +800 deg. F.; catalog 93, resistance thermometers—indicating, recording and controlling.

Instruments. Esterline-Angus Company, Indianapolis, Ind.—Bulletin 529—describes the use of time and operation recorders.

Metals and Alloys. American Manganese Steel Company, Chicago Heights, Ill.—Folder describing "Amsco" steel for wear resistance, and "Fahrlooy" steel for corrosion and heat resistance.

Metals and Alloys. Central Alloy Steel Corporation, Massillon, Ohio; Ludlum Steel Company, Watervliet, N. Y.; Babcock & Wilcox Tube Company, New York, N. Y.—Catalog describing Enduro KA2 steel, a Nirosta steel made under the Krupp-Nirosta patents.

Metals and Alloys. Ludlum Steel Company, Watervliet, N. Y.—Bulletin describing Nitrallloy and the nitriding process.

Metals and Alloys. New Jersey Zinc Sales Company, 160 Front St., New York, N. Y.—Catalog describing zinc alloys for die casting.

Mixing Equipment. Alsop Engineering Company, 47 West 63d St., New York, N. Y.—New catalog on portable electric mixers and glass-lined mixing tanks.

Monsanto. Monsanto Chemical Works, St. Louis, Mo.—Bulletin describing the industries and industrial opportunities offered by the town of Monsanto, Ill.

Pumps. U. S. Stoneware Company, Akron, Ohio.—Bulletin D—describes two new stoneware centrifugal acid pumps.

Pumps. Yeomans Brothers Company, 1433 Dayton St., Chicago, Ill.—Bulletin B3400—completely describes heavy-duty bilge pumps.

Power Generation. Yarnall-Waring Company, Chestnut Hill, Philadelphia, Pa.—Catalog WG-1802, describes floatless alarm water columns and inclined water gages.

Refractories. Jonathan Bartley Crucible Company, Trenton, N. J.—"Lawtonite Refractory Facts," booklet giving many actual savings through the use of Lawtonite refractories; also folder on "Brick Life," a compound for strengthening and prolonging the life of firebrick.

PATENTS ISSUED

May 7 to May 28, 1929

Pulp, Paper, Glass and Sugar

Process for the Production of Chemical Wood Pulp. Donald B. Bradner, Hamilton, Ohio, assignor to Champion Coated Paper Company, Hamilton, Ohio.—1,711,584.

Method of Making Wood Pulp. Howard F. Weiss, Madison, Wis., assignor to Bauer Brothers Company, Springfield, Ohio.—1,711,706.

Paper Machine. Robert Edward Argy, Niagara Falls, N. Y.—1,712,375.

Web Carrier for Papermaking Machines. William E. Sheehan, Albany, N. Y.—1,712,587.

Glass-Pressing Machine. Max Jaeger, Long Island City, N. Y., assignor to Anchor Cap & Closure Corporation, Long Island City, N. Y.—1,712,499.

Paper-Pulping Engine. Walter Werner, Hoosick Falls, N. Y., assignor to Noble & Wood Machine Company, Hoosick Falls, N. Y.—1,712,598.

Beating Engine. Walter Werner, Hoosick Falls, N. Y., assignor to the Noble & Wood Machine Company, Hoosick Falls, N. Y.—1,712,599.

Agar Product and Method of Producing the Same. John Becker, San Diego, Calif.—1,712,785.

Apparatus for Carrying Out Electrolytic Reduction of Sugars to Alcohols. Henry Jermain Creighton, Swarthmore, Pa., assignor to Atlas Powder Company, Wilmington, Del.—1,712,952.

Process for Effecting a Reaction Between Sucrose and Quicklime. Ralph W. Shafer, Denver, Colo.—1,713,925.

Paper-Making Machine. Charles W. Valentine and Alfred F. Helin, Watertown, N. Y., assignors to the Bagley and Sewall Company, Watertown, N. Y.—1,713,988.

Paper-Making Machine. Charles E. Pope, deceased, Springfield, Mass., by Mary A. Pope, executrix, Springfield, Mass., assignor to Great Northern Paper Company, Millinocket, Me.—1,714,238.

Process for Manufacture of Extra Fine Soft Granulated Sugar. Bernard H. Varau and Truman B. Wayne, Sugar Land, Tex.—1,715,049.

Rubber, Rayon and Synthetic Plastics

Process for the Dyeing of Artificial Silk. Winfrid Hentrich, Wiesdorf-on-the-Rhine, and Rudolf Knoche, Leverkusen-on-the-Rhine, Germany, assignors to Grasselli Dyestuff Corporation, New York, N. Y.—1,711,890.

Process of Making Cellulose Esters of High Uniformity. Harry Le B. Gray, Rochester, N. Y., assignor to Eastman Kodak Company, Rochester, N. Y.—1,711,940-1.

Celluloid Compound. Rudolf Roland, Jackson Heights, N. Y., assignor to Roland Fireproof Celluloid Corporation, Flushing, N. Y.—1,713,482.

Method of Manufacturing Hollow Rayon Fibers. Walter O. Snelling, Allentown, Pa.—1,713,679.

Method of Reclaiming Vulcanized Rubber. Tatsuchi Yokoyama, Tokyo-Fu, Japan.—1,714,835.

Petroleum Refining and Processing

Process of Making Filtration and Decolorizing Adsorbents. Harold T. Maitland, Sharon Hill, Pa., assignor to Sun Oil Company, Philadelphia, Pa.—1,711,504.

Process for the Continuous Distillation of Hydrocarbons with Simultaneous Cracking of High-Boiling into Low-Boiling Hydrocarbons. Hermann Wolf, Bad Homburg vor der Höhe, Germany, assignor to Carburo Aktiengesellschaft, Schaffhausen, Switzerland.—1,711,869.

Pressure Distillation of Heavy Hydrocarbon Oils. Robert E. Wilson, Chicago, Ill., assignor to Standard Oil Company, Whiting, Ind.—1,712,187.

Process of Refining Hydrocarbon Oils. Harry Karl Ihrig, Berkeley, Calif., assignor to Associated Oil Company, San Francisco, Calif.—1,712,619.

Method and Apparatus for Condensing Vapors. William Hildebrandt, Washington, D. C., assignor to Gasoline Corporation, New York, N. Y.—1,712,825.

Method of Separating Solids from Oil. John C. Deacon, Bakersfield, Calif., assignor by mesne assignments, to Standard Oil Company of California, San Francisco, Calif.—1,713,117.

Method of Refining Mineral Oils. Arthur Lachman, Berkeley, Calif., assignor to Richfield Oil Company of California, San Francisco, Calif.—1,712,960.

Apparatus for Recovering Gasoline. Harold B. Bernard, Tulsa, Okla., assignor to Sinclair Oil & Gas Company, Tulsa, Okla.—1,713,323.

Art of Cracking Hydrocarbons. Eugene C. Herthel, Chicago, Ill., and Harry L. Pelzer, Highland, Ind., assignors to Sinclair Refining Company, New York, N. Y.—1,714,090.

Distillation of Oil. Albert E. Miller, Westfield, N. J., assignor to Sinclair Refining Company, New York, N. Y.—1,714,097.

Dewaxing of Oil. Ernest B. Phillips, East Chicago, Ind., and James G. Stafford, Chicago, Ill., assignors to Sinclair Refining Company, Chicago, Ill.—1,714,133.

Process of Distilling Mineral Oil. Arthur E. Few, Jr., Bryn Mawr, and Henry Thomas, Ridley Park, Pa., assignors to Sun Oil Company, Philadelphia, Pa.—1,714,811-2.

Apparatus for Treating Oils. William R. Howard, Washington, D. C., assignor to Universal Oil Products Company, Chicago, Ill.—1,715,066.

Prevention of Substantial Corrosion in Hydrocarbon-Oil-Treating. Apparatus. Jacques C. Morrell and Harry P. Benner, Chicago, Ill., assignors to Universal Oil Products Company, Chicago, Ill.—1,715,095.

Method and Apparatus for Treating Compounds Preferably of a Hydrocarbon Nature. William John Knox, New York, N. Y., assignor, by mesne assignments, to Petroleum Conversion Corporation.—1,715,239.

Coal Processing and Combustion

Method of Hydrogenating and Treating Carbonaceous Materials. Max Hofsäse, Mannheim-Neustadt, Germany.—1,711,499.

Process and Apparatus for Distilling Solid Carbonaceous Material. Heinrich Koppers, Essen-Ruhr, Germany.—1,712,082-8.

Method of Making Water Gas. Caler Davies, Jr., Poland, Ohio.—1,712,983.

Apparatus for Use in Drying and Distilling Lignite, Peat, Non-Coking Coals, and Other Similar Carbonaceous Matter. Hubert Debauche, near Charleroy, Belgium.—1,713,032.

Gas Scrubber. Gustave Fast, Annapolis, Md.—1,713,175.

Method of Producing Mixed Coal Gas and Water Gas. Frederick Deacon Marshall, Weybridge, England.—1,713,189.

Heating Substance Susceptible to Oxidation. Heinrich Koppers, Essen-Ruhr, Germany, assignor to Koppers Development Corporation, Pittsburgh, Pa.—1,713,834.

Aeration Apparatus and Method. Frederick W. Sperr, Jr., Pittsburgh, Pa., assignor to Koppers Company, Pittsburgh, Pa.—1,713,967.

Coke Oven. Joseph van Ackeren, Pittsburgh, Pa., assignor to Koppers Company, Pittsburgh, Pa.—1,714,933.

Pitch-Coking Process. Heinrich Koppers, Essen-Ruhr, Germany, assignor to Koppers Development Corporation, Pittsburgh, Pa.—1,715,240.

Organic Processes

Manufacture of Hydrocyanic Acid. Reinhold Fick, Ludwigshafen-on-the-Rhine, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt-on-the-Main, Germany.—1,712,297.

Purifying Alcohols. Hyym E. Buc, Roselle, N. J., assignor to Standard Oil Development Company.—1,712,475.

Hydrogenation of Aromatic Bases. Wilhelm Lommel, Wiesdorf-on-the-Rhine, and Theodor Goost, Leverkusen-on-the-Rhine, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfurt-on-the-Main, Germany.—1,712,709.

Process of Producing Benzoic Acid. Herbert W. Daudt, Penns Grove, N. J., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del.—1,712,753.

Method of Activating Carbon. Jacques C. Morrell, Oak Park, Ill.—1,712,930.

Method of Making Chloroacetic Anhydride. Charles J. Strosacker and Clarence C. Schwieger, Midland, Mich., assignors to Dow Chemical Company, Midland, Mich.—1,713,104.

Manufacture of Nitrocellulose Smokeless Powder. Alan Spencer Hawkesworth, Washington, D. C.—1,713,505.

Method of Activating Carbon. Jacques C. Morrell, Oak Park, Ill.—1,713,347.

Apparatus for the Distillation of Fatty Acids, Glycerin and the like. Wilhelm Gensecke, Bad Homburg, Germany.—1,713,431.

Process for the Manufacture of Acetaldehyde. Willy O. Herrmann and Hans Deutsch, Munich, Germany, assignors to Consortium für Elektrochemische Industrie, Munich, Germany.—1,714,783.

Method of Refining Rosin. Irvin W. Humphrey, Wharton, N. J., assignor to Hercules Powder Company, Wilmington, Del.—1,715,083-8.

Inorganic Processes

Process of Making Crystallized, Non-Caking Trisodium Phosphate Hydrate. Leon R. Westbrook, Cleveland Heights, Ohio, assignor, by mesne assignments, to Grasselli Chemical Company, Cleveland, O.—1,711,707.

Reducing Zinciferous Materials. Frank G. Breyer and Earl H. Bunce, Palmerton, Pa., assignors to New Jersey Zinc Company, New York, N. Y.—1,712,132-4.

Concentration of Brines. William E. Burke and Harold De Ropp, Trona, Calif., assignors, by mesne assignments, to American Potash & Chemical Corporation, New York, N. Y.—1,712,787.

Treatment of Light Metal Alloys. John A. Gann, Midland, Mich., assignor to Dow Chemical Company, Midland, Mich.—1,712,989-90.

Process of Producing Oxides of Nitrogen from Ammoniacal Liquor. David L. Jacobson, Pittsburgh, Pa., assignor to Koppers Company.—1,713,045.

Method of Producing Hydrogen. Frank C. Blake, deceased, Wilmington, Del., by Roberta L. Blake, administratrix, Wilmington, Del., assignor to Lazote, Inc., Wilmington, Del.—1,713,325.

Method for Making Aluminum Oxide from Aluminum Sulphide. Freiherr Conway von Girsawald, Frankfurt-on-the-Main, Germany.—1,713,411.

Manufacture of Calcium Hypochlorite. Anthony George, Niagara Falls, and Robert B. MacMullin, La Salle, N. Y., assignors to Mathieson Alkali Works, Inc., New York, N. Y.—1,713,650, 64, 68, 69.

Process of Treating Acidulous By-Product Calcium Sulphate. Robert Seaver Edwards, Milton, Mass., assignor to Rumford Chemical Works, Providence, R. I.—1,713,868.

Sulphur-Burning Apparatus. Otto Buse, Cleveland, Ohio, assignor, by mesne assignments, to Grasselli Chemical Company, Cleveland, Ohio.—1,714,657.

Phosphoric-Acid Recovery. Edouard Du Bois Mathey, Cranford, N. J., and Audley Oscar Williams, Brewster, Fla., assignors to American Cyanamid Company, New York, N. Y.—1,714,685.

Process of Making Phosphorus Nitride. Claude G. Miner, Berkeley, Calif.—1,715,041.

Chemical Engineering Processes and Equipment

Method and Apparatus for Centrifugal Treatment of Substances. Leo D. Jones, Philadelphia, Pa., assignor to Sharples Specialty Company, Philadelphia, Pa.—1,711,533.

Method of Impregnating With a Compound. Charles F. Coleman, Philadelphia, Pa., assignor to F. J. Stokes Machines Company, Philadelphia, Pa.—1,711,774.

Concentrator. Albert H. Stebbins, Los Angeles, Calif.—1,712,559.

Compressor or Vacuum Air Pump. Franz Lawaczek, Munich, Germany, assignor to Worthington Pump & Machinery Corporation, New York.—1,712,625.

Lifter for Salt Grainers. Thorvald C. Colbjørnsen, Antonito, Colo.—1,712,651.

Hydraulic-Cement Composition and Process of Producing Same. Lennart Forsén, Gerknas, Finland.—1,712,818.

Centrifugal Control. Robert Alexander Steps, Los Angeles, Calif.—1,713,057-8.

Filtering Material. Henry Blumenberg, Jr., Los Angeles, Calif.—1,713,250-1.

Process for Distilling Liquid Mixtures. David G. Brandt, Westfield, N. J., assignor, by mesne assignments, to Heat Treating Company, New York, N. Y.—1,713,254-6.

Apparatus and Process for Making Cement. John E. Velsy and Walter T. Groner, Dayton, Ohio, assignors to Southwestern Portland Cement Company, Dayton, Ohio.—1,714,060.

Centrifugal Separator. Benjamin Charles Carter, South Farnborough, England.—1,714,658.

Apparatus for Pulverizing Materials. William T. Doyle, Boston, Mass., assignor to Sturtevant Mill Company, Boston, Mass.—1,715,123.

NEWS of the Industry

Producers of Naval Stores Adopt Trading Code

A CODE of trade practices for the steam and solvent branches of the naval stores industry was adopted at a conference held by the producers under the auspices of the Federal Trade Commission on June 11. The conference condemned such practices as price discrimination, secret rebating, inducing breach of contract, misrepresentation, etc., and submitted its resolutions thereon for the consideration of the commission. Commissioner Garland S. Ferguson, who presided at the conference, stated that several of the resolutions were broader in their application or meaning than the commission could approve.

The first resolution provides that the products sold by each member of the steam and solvent class of the industry shall be sold only upon open prices and terms, publicly announced and strictly adhered to. The conference also went on record against secret rebating, inducing breach of contract, and misrepresentation of products. A declaration against sales under any form of guarantee to the purchaser against either advance in price or protection against decline in price was adopted.

Distribution by each producer of his current price lists, including terms of sale, and of all subsequent changes when made, was approved in a resolution adopted by the conference. Commissioner Ferguson stated that the commission could not approve this resolution.

A resolution condemning the acceptance of orders at old prices following announcement of price changes may be accepted by the commission in principle.

A resolution condemning consignment by a producer of any of his products to any but his authorized distributor met with questions from both Commissioner Ferguson and E. Markham Flannery, director of the Trade Practice Conference Division of the commission, as to the intent of the proposal.

A resolution defining the jobbers' functions and setting forth conditions with respect to resale prices was adopted by the conference but doubt was expressed by Commissioner Ferguson regarding the attitude of the commission on the policy proposed by the producers. Repudiation of contracts and orders was condemned. Concerning sales policy, the conference adopted a resolution recognizing that the producer acting independently should formulate his own policy of distribution. The resolution provided that each pro-

ducer shall furnish the institute with an outline of his policy, showing terms, quantity discounts, or quantity differentials and all other pertinent details, together with a list of all his sales offices, authorized distributors and agents. Under the terms of the resolution, any changes in this announced policy must be reported to the institute. It is also agreed that the members of the institute shall not sell any authorized distributor or agent of another member without that member's consent. Commissioner Ferguson stated that this rule would not receive the approval of the commission.

The Mackie Pine Products Company was the only member of the steam and solvent group which was not represented at the conference. The companies which participated in the conference, and the representatives present, were the Newport Company, represented by S. J. Spitz, J. H. McCormick, and E. E. Holdman; Continental Turpentine & Rosin Corporation, represented by F. W. Kressman and W. H. Crawford; Dixie Pine Products Company, represented by T. F. Dreyfus and Sidney Lowenstein; and the Hercules Powder Company, represented by L. N. Benet, Jesse Gibson, J. C. Haile, and J. E. Lockwood.

German I. G. Acquires New Tanning Process

A REPORT from Consul R. W. Heingartner, Frankfort on the Main, says that the I.G. Farbenindustrie has acquired a new tanning process from the firm of Ernst Luchaus, of Duisburg, through the employment of which the synthetic tanning materials manufactured by the I.G. can be utilized to a greater extent. The I.G. at the same time took over a new drying and greasing process from Luchaus which is said to be an improvement over the old processes. Agreements have been made according to which the processes are to be worked by both concerns in a factory to be constructed for this purpose. The Duisburg plant has been reorganized and is to be used for laboratory purposes only. The new tanning process has not only the advantage of shortening the time required for the tanning—only eight or ten days is required for the tanning of the very best sole leathers as compared with many months heretofore required for the same qualities—but it allows considerable capital saving and at the same time provides an extensive field for the I.G.'s synthetic tanning materials.

Production Meeting Held by Gas Engineers

ALL PHASES of the production of city gas received technical consideration at the production conference of the American Gas Association, held in Baltimore, Md., May 27 to 29. The six sessions of the conference were attended by approximately 400 engineers and chemists of the industry. The meeting was under the auspices of the three principal technical committees of the association having to do with these matters and the sessions were presided over by the respective chairmen of these committees: John H. Wolfe, water gas; H. J. Rose, chemical; and J. V. Postles, carbonization committee.

Modern trends and improved methods of water-gas making constituted the principal theme of two sessions which are reviewed rather fully in the technical summary given elsewhere in this issue of *Chem. & Met.* The carbonization committee presented a paper by S. B. Sherman, of Racine, Wis., describing the new vertical-chamber oven plant now operating in that city. Results described indicate the very satisfactory mechanical performance and the excellent yields being obtained in this new type of plant. This committee also reported the extended work being done on improvement of gas-producer operation, including studies of new types of producers recently developed.

It was noted throughout the sessions that the participation of chemists in all phases of gas-making is increasingly important. Practically all of one session of the conference was devoted to a discussion of the ways in which chemical control is now utilized for betterment of water-gas, coal-gas, and holding company operations. In the other chemical session the same factor of chemical contribution to plant efficiency was brought out in the paper by S. T. Powell.

New Plant Ships Helium

The first shipment of helium from the new Bureau of Mines plant located near Amarillo, Texas, occurred on May 6. On that date a tank car containing 200,000 cu.ft. of practically pure helium was shipped to Langley Field, Va., for army use. This plant of the Bureau utilizes a somewhat new process, developed by the Bureau itself. It has a capacity for production of approximately 30,000 cu.ft. of 97-98 per cent helium per day.

Hearings on Chemical Schedule Opened

HEARINGS on the chemical schedule opened June 14 before a subcommittee of the Senate Finance Committee comprising Senators Smoot (chairman), Reed and Edge, Republicans; King and Barkley, Democrats. Approximately 60 witnesses were scheduled to appear during the 4-day session, although Senator Smoot announced at the outset of the hearings that no testimony would be heard that previously had been presented before the House Ways and Means Committee. For that reason the committee declined to hear Salmon W. Wilder, representing the Manufacturing Chemists Association, Boston, who had intended to present the views of the chemical industry as a whole with respect to tariff revision.

An increase in the duty on formic acid from 4 cents per pound provided in the House bill to 6 cents per pound was requested by James M. Gillet, Victor Chemical Works, Chicago. The existing rate, under Paragraph 5, is 25 per cent, the equivalent of 2 cents a pound. Mr. Gillet stated that the same duty is desired on formic as on oxalic acid, now dutiable at 4 cents a pound, which is increased to 6 cents a pound in the House bill.

A. Edwin Fein, Sparklets, Inc., New York City, asked for the transfer to the free list of filled liquid carbonic-acid-gas containers for home use now dutiable at 25 per cent ad valorem under Paragraph 5. Mr. Fein stated that a new use for this product is charging waffle batter with the gas, in lieu of using baking powder. It is also used for aerating ice cream mix, whipping cream and similar products.

A duty of 50 per cent on fatty acids and mixtures in chief value of fatty acids, was urged by F. F. Jordan, National Association of Stearic Acid Manufacturers, Cincinnati. Mr. Jordan stated that stearic acid now is dutiable at $1\frac{1}{2}$ cents per pound, the equivalent of $12\frac{1}{2}$ per cent ad valorem, on the high grades, and 25 per cent ad valorem on low grades. In the House bill stearic acid takes a uniform rate of duty of 25 per cent. The 50 per cent rate proposed by Mr. Jordan also would apply to red oil (oleic acid). The present duty on that oil is $1\frac{1}{2}$ cents per pound.

An increase in the tariff on glycerine from 1 cent to 4 cents per pound on the crude and from 2 cents to 6 cents per pound on refined (Paragraph 43) was requested by Mr. Jordan. No change was made in the present duties on this product by the House bill.

A provision that all articles specified by name in Paragraphs 1 and 7 shall be free of duty when imported for fertilizer purposes, was proposed by Chester H. Gray, American Farm Bureau Federation, Washington. In Paragraph 7, ammonium chloride is dutiable at $1\frac{1}{4}$ cents per pound; ammonium nitrate at 1 cent per pound; ammonium phosphate at $1\frac{1}{2}$ cents per

pound, and ammonium sulphate at $\frac{1}{4}$ cent per pound. These duties were not changed in the House bill. In Paragraph 1, phosphoric acid is dutiable at 2 cents per pound. In the new bill the rate is the same for phosphoric acid containing by weight of phosphoric acid less than 80 per cent. When containing 80 per cent or more a duty of $3\frac{1}{2}$ cents per pound is recommended.

Mr. Gray urged that all starches should take a uniform rate of duty. An increase from $1\frac{1}{4}$ to $2\frac{1}{2}$ cents per pound on potato starch is carried in the House bill.

W. S. Moscrip, National Co-operative Milk Producers' Federation, St. Elmo, Minn., requested an increase from $2\frac{1}{2}$ cents to 8 cents per pound on casein and the transfer of the product from Paragraph 19, Schedule 1, to Paragraph 7, with the dairy products. This proposal also was supported by John McGrath, Vermont Federated Creameries, Milton, Vt., and W. F. Jensen, American Association of Creamery Butter Manufacturers, Chicago.

Fertilizer Men Hold Annual Convention

THREE major themes received attention at the annual convention of the National Fertilizer Association, attended by approximately 500 members of the industry, at New London, Conn., June 10 to 13. These topics were: present status and trends in development of phosphate rock and superphosphate, the economic development of the fertilizer business and its interrelation with the welfare of agriculture, and the bettering of the trade practices of the industry.

The business sessions of the convention disclosed the continued prosperous condition of the association, with its annual budget of approximately \$250,000, divided about equally between soil improvement committee work and all other activities, including central office administration. The newly elected members of the board of directors of the association include the following eight persons, the first four named being district representatives and the second four members at large: C. Wilbur Miller, Davison Chemical Company, Baltimore, Md.; J. Ross Hanahan, Planters Fertilizer & Phosphate Company, Charleston, S. C.; George Cope, Chatham Chemical Company, Savannah, Ga.; Wood Crady, Federal Chemical Company, Louisville, Ky.; Robert S. Bradley, American Agricultural Chemical Company, New York City; J. E. Sanford, Armour Fertilizer Works, Chicago, Ill.; Judge Charles G. Wilson, Virginia Carolina Chemical Corporation, Richmond, Va.; and W. T. Wright, F. S. Royster Guano Company, Norfolk, Va.

Immediately following the convention the new board of directors met for the election of officers. Those selected were: President, L. W. Rowell, general manager, Fertilizer Department, Swift

McGraw-Hill Launches "The Business Week"

A new type of service in gathering and interpreting business news and economic developments is seen in the announcement that after Sept. 7, 1929, *The Magazine of Business* will be published as *The Business Week*. The new McGraw-Hill magazine will be designed to serve in a unique capacity the need of the American business man for brief, carefully sifted news on every important development and trend of business. It will be manned by a staff of outstanding economists and specialists in the different fields of business interest. It will have a far-flung news-gathering organization supported by the editorial and reportorial resources of McGraw-Hill company.

Second only to its major function of news will be its interpretation of business conditions, which will be developed so as to forecast future business trends with accuracy and promptness.

& Company; vice-president, Bayless W. Haynes, president, Wilson & Toomer Company, Jacksonville, Fla.; executive secretary and treasurer, Charles J. Brand. One important change was made by the association in the organization for the coming year of its soil improvement committee work under H. R. Smalley, who will head all the work of both northern and southern districts. This reorganization was a consequence of the resignation of J. C. Pridmore, who formerly headed the southern division work.

Two of the three convention sessions were devoted almost entirely to addresses by technical men discussing phosphate technology and economics or trends in the technical development of the industry. The great emphasis placed on phosphate rock and superphosphate developments at the convention indicated the increased attention being given to this plant-food constituent. The discussion showed that more important developments are anticipated in this phase of the industry's work during the next few years than in connection with either nitrogen or potash. A technical résumé of this part of the association program will be presented in *Chem. & Met.* next month.

It was announced at the convention that the Federal Trade Commission has approved, with slight modification in language, the three resolutions defining unfair trade practices which were adopted by the conference of the industry meeting with the Commission representatives on Jan. 29. The formal approval by this government agency of these resolutions and definitions of unfair trade practice will make it practically illegal for any fertilizer company longer to indulge in the condemned practices.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

SENTIMENT in the Senate is such that the failure of tariff legislation looms as a possibility. Apparently the insurgent Republicans and the Democrats are planning to reduce rates on manufactured articles and to raise rates on agricultural products. If they are successful in boosting some of the rates to unreasonable levels, and hold them in the conference bill, the measure would be in imminent danger of receiving the presidential veto.

This probably would mean no bill at all. So far as the chemical industry as a whole is concerned this is better, it is believed, than a new law with an 80-cent duty on flaxseed; high rates on oils and fats and an 8-cent duty on blackstrap molasses.

There is reason to believe that the bill which passed the House is far from pleasing to the President. He urged a very limited revision. Instead extensive changes have been made outside the agricultural schedules and outside of the relatively few items where excessive imports are taking place. Some of the rates in the agricultural schedule are regarded by some as being unnecessarily high. If these are forced to new high levels and other items, left untouched by the House, are added, it is apparent that the bill will be thrust into a dangerous position. Many of such rates probably would be reduced in conference but it is feared by some of the friends of the measure that the conference committee might not be able to alter the measure to the point where it would be acceptable to the President.

THE effort to help the farmer involves several important items in the chemical schedule. The duty on flaxseed was increased by action under the flexible provisions of the act to 56 cents. This was ratified by the Ways and Means Committee in fixing that amount in its original bill. Later, under pressure, the committee agreed to an increase to 63 cents. Now some of the farm groups are urging a rate of 80 cents.

The advocates of an 8-cent rate on blackstrap molasses are leaving nothing undone in their preparations to impress the Senate. This whole campaign is being predicated on the assumption that corn will replace blackstrap as a source of alcohol. While the fact will be brought to the attention of the Senate that the domestic industry is not so located or so organized as to make use of corn beyond about one-fifth of domestic requirements, it is likely under the present political lineup in the Senate that careful attention will be paid to fundamental facts. Attention has been called to the fact that such a rate would promote the manufacture of synthetic alcohol from natural gas and carbide, but the suggestion is not taken seriously.

The fact that ethyl alcohol is the most important of the organic compounds used by chemical and allied industries makes for particular interest in the fight over blackstrap. While it is believed that the chances of boosting the rate to 8 cents is remote, the fear is that a compromise on the 2-cent rate may result, which, it is contended, would benefit no one and simply would make trouble.

Dairy and farm interests still are striving for high rates on oils and fats. While their views are not likely to prevail in the committee, there again is question as to what may happen on the Senate floor.

Farm influence continues to be exerted in favor of menthol on the mistaken assumption that this will help the peppermint growers of the Middle West.

Fewer increases were made by the House in the chemical schedule than in any other subdivision of the bill. The total increase is 3 per cent over the Fordney-McCumber rates.

Further changes in the tariff bill, as amended since the analysis given in last month's issue, are here tabulated. Duties are in cents per pound unless otherwise noted.

Paragraph	Item	Proposed Rate
5	Stearic acid.....	25%
	Oleic acid or red oil.....	25%
11	Bleaching shellac.....	20%
20	Chalk, whitening, or Paris white; dry, ground or bolted.....	0.4%
52	Menthol.....	75%
54	Olive oil.....	81%
67	Paints, colors and pigments	
	1. Not assembled in sets or kits, value less than 20c. per doz. pieces.....	40%
	2. Value 20c. or more per doz; in tubes or jars.....	2c. ea. plus 40%
	In cakes, pans, etc., not over 1½ lb. net weight	1½c. ea. plus 40%
	3. In bulk or over 1½ lb.....	40%
71	Bone black or bone char, and blood char.....	25%
98	Wood tar, pitch of wood, tar oil from wood.....	1%
760	Flaxseed.....	63%

IT IS not expected that the Senate committee will make any fundamental changes in the chemical schedule as approved by the House. The schedule is in charge of sub-committee No. 1 of the Senate Finance Committee, which is composed of Senator Smoot, of Utah; Senator Edge, of New Jersey; Senator Reed, of Pennsylvania; Senator King, of Utah; and Senator Barkley, of Kentucky. The three Republicans on the committee are in full sympathy with the effort to establish a vigorous domestic chemical industry. Senator King, one of the two Democrats on the sub-committee, has been outstanding in his fight against high duties on chemicals. Senator Barkley is a conservative and it is expected that he will be governed by the weight of the evidence presented in connection with the respective items.

One of the reasons thought to be influencing the attitude of the administration to take a very determined stand

against any rates that cannot be justified fully is the international aspect of the tariff. While there is no disposition to deny American farmers rates that will give them all the protection needed, there is firm opposition to rates that accomplish little for domestic producers and make for great irritation abroad. This is particularly the case with Canada, which is our best customer.

EUROPEAN developments in the chemical industry and trade will be discussed at a conference in Paris early in August by field representatives of the Department of Commerce specializing in that field. It is probable that the department in Washington will be represented by C. C. Concannon, chief of the Chemical Division of the Bureau of Foreign and Domestic Commerce. The conference will be open to any representatives of the domestic industry and it is expected that one or more members of the chemical advisory committee of the department will attend.

A conference in Washington next spring between representatives of the domestic industry and the department's representatives abroad is being planned in response to a request by the chemical advisory committee. A regular cycle of annual conferences is expected to follow, the department withdrawing first one group and then another from their posts to discuss current developments with the men in the industry at home.

Now approaching final enactment, the legislation authorizing the decennial census will provide a broader statistical evaluation of the nation's natural resources, manpower, manufactures and consumption than has ever been attempted in the past. In addition to the count of the population and a census of unemployment, there will be a census of industrial production, of distribution, of agriculture and livestock and of mining. A survey of irrigation and drainage also is provided for.

The feature of the census is the provision for the tabulation of inter-industry, wholesale and retail sales of all manner of products. The recommendation for such a census was first made by Mr. Hoover in 1925, when, as Secretary of Commerce, he declared that the basic facts on production are available but that distribution presents a blank picture. Looking forward to the first national census of distribution, the Department of Commerce has conducted several trial censuses in various cities of inter-industry, wholesale and retail business.

It has always been the policy of the Chemical Warfare Service to co-operate with the chemical industry and with the civilian activities of the United States and that policy will not be changed, according to Major General Harry L. Gilchrist, who succeeded Major General Amos A. Fries on March 29 as chief of this branch of the military establishment. Where valuable information is uncovered during the research work of the service that can be applied to civil or commercial uses, such information is passed along wherever it is possible, said General Gilchrist.

Concession Granted for Exploitation of Dead Sea Resources

New York Corporation Listed Among Financial Supporters

From our London Correspondent

A MARKED increase in the number of visitors from the United States is anticipated generally this year, and particularly to the annual meeting of the Society of Chemical Industry, which is to be held in Manchester from July 8 to July 13. Dr. Arthur D. Little, of Cambridge, Mass., president of the society, will give added distinction to this meeting, and in honor of the occasion he is to receive from Manchester University the honorary degree of Doctor of Science. Recent utterances by the president elect, Dr. Levinstein, indicate an imperial orientation, inasmuch as an attempt may be made to establish closer and more intimate contact with the British dominions and colonies and provide a more efficient news service in regard to the outposts of the Empire.

The retirement of Dr. Longstaff, secretary of the society, will be noted with regret by his many friends in the United States, but his services will still be available as a member of council. As usual, it is only after retirement that services are appreciated at their true value, and had the times been less difficult the results obtained would have been more startling. Actually societies and institutions are passing through a transition period with relatively stationary membership, and it is only the renewed hope and prospect of a Chemistry House that gives confidence in their economic and vigorous future.

THE DEAD SEA controversy has now been brought to an end by definite granting of the concession for the exploitation of its mineral resources. The terms of the concession are fairly stringent, but the financial arrangements made by the concessionnaires, Major Tulloch and Mr. Novomeysky, inspire confidence in the future. The term of the concession is for 75 years and for 25 years the concessionnaires have the exclusive right to extract mineral salts from the Dead Sea and thereafter have the first option on any proposed further concession.

Potassium chloride of 80 per cent purity is to be produced on an increasing scale, ranging from 1,000 tons in the third year to 50,000 tons in the tenth year and thereafter, all subject to a royalty of 5 per cent on the value in bulk at works, payable to the government. Moreover, the latter participates in any profits above 10 per cent on a sliding scale of 20 to 30 per cent of surplus profits. Messrs. C. Tennant Sons & Company, Pauling & Company, Leslie Urquhart of the Russo-Asiatic Consolidated Company, the Jewish Colonial Trust, Ltd., and the Palestine Economic Corporation of

New York, are the financial supporters, and Mr. Flexner and Felix Warburg, chairman and vice chairman of the latter concern, have already joined the board of the operating company, the chairman of which is to be the Earl of Lytton.

There has been considerable controversy in regard to the nuisance from super-power stations, especially when these, as in the case of the Battersea Station, are planned within the limits of the City of London. Complaints from local residents have in the past been ineffective, but there can be no doubt that the increasing scale upon which power is generated in coal-consuming stations does cause not only nuisance in regard to the dissemination of fine particles of ash but also graver damage from the action of sulphur fumes on buildings and other structures. The results have been somewhat amusing, inasmuch as it was blandly hoped that "the chemist" could with the greatest ease recover or remove the sulphur from the chimney gases, and apparently there is some disappointment at the obvious reply that time and research may be needed to find the economic solution. The contract having been placed for the power station, it is now rather a difficult matter to consent to its erection further down the river or at some more remote place than Battersea.

AN INTERESTING recent development is disclosed by the flotation of the N. T. Artificial Wool Company, which claims to manufacture from vegetable fiber by a French process a substitute which behaves and dyes like wool. Dr. Lilienfeld, whose name is familiar in connection with the special high-grade silk which is being developed jointly by the Courtaulds and Nuera companies, is reported to have concluded arrangements with the British Cyanides Company in regard to development of his recent technical developments in synthetic resins. The latter company, it will be remembered, recently made arrangements in America for exploitation of its processes in this direction.

In the low-temperature carbonization field, progress is reported with the Bussey system, and an interesting newcomer which may ultimately be successful is the Continuous Coal Carbonization Company, which is operating an experimental unit recently modified by experience, and on the lines of a continuous traveling conveyor in a tunnel kiln. The problems of efficient heat transmission and easy removal of the semi-coke have been solved in an ingenious manner.

The press has been used to ventilate expert opinion in regard to the present price of radium, for which about \$2,000,000 has recently been raised in order to obtain supplies for the treatment of cancer, etc., in the hospitals. Apparently the United States supplies, after killing Bohemian competition, were in turn overshadowed by the high-grade ores of the Belgian Congo and the controversy has brought out the fact that there has been no profiteering in this essential business. Attention has now, however, been drawn to some of the resources available in the British Empire and it would not be surprising if Imperial Chemical Industries, Ltd., were asked to turn attention to its economical recovery on the desired scale.

Lammot duPont President of Chemists' Association

THE Manufacturing Chemists' Association held its annual meeting at the duPont-Biltmore Hotel, Wilmington, Del., on June 6-7. The Synthetic Organic Chemical Manufacturers' Association also met at the same time and a dinner under the auspices of the two associations was held on the evening of June 6. At the business meeting of the Manufacturing Chemists' Association the following officers were elected for the ensuing year: President, Lammot duPont, of E. I. duPont de Nemours & Co., Wilmington; vice-presidents, William B. Bell, of the American Cyanamid Company, New York, and W. D. Huntington, of the Davison Chemical Company, Baltimore; treasurer, Philip Schleussner, of the Roessler & Hasslacher Chemical Company, New York; secretary, John I. Tierney, Washington.

The executive committee for the coming year will comprise S. W. Wilder, of the Merrimac Chemical Company, chairman; Dr. Charles L. Reese, of E. I. duPont de Nemours & Co., Wilmington; William H. Bower, of the Henry Bower Chemical Manufacturing Company, Philadelphia; C. W. Millard, of the General Chemical Company, New York; H. L. Derby, of the Kalbfleisch Corporation, New York; George W. Merck, of Merck & Co., Rahway, N. J.; J. A. Rafferty, of the Carbide & Carbon Chemical Company, New York.

Henry Howard, the retiring president, in his presidential address stated that for him the meeting represented the close of 25 years of active service in the association. He became chairman of the executive committee in 1904 and acted in that capacity until 1926, when he assumed the office of president. In his address Mr. Howard said that he thought that perhaps the interests of the chemical industry of the United States could be better represented and at less cost if the various associations connected with the industry were all brought together in one organization, possibly somewhat along the lines of the Chemical Alliance, which functioned so well during the war.

Society of German Chemists Holds General Meeting

Papers Read Disclose Progress in Metallurgy
and Chemical Engineering

From our Berlin correspondent

THE LEADING point of chemical interest recently has been the general meeting in Breslau of the Verein Deutscher Chemiker — that is, the Society of German Chemists. Among the timely subjects presented was the paper by Professor Stock on beryllium, which has recently been produced in considerable quantities and displays a number of valuable properties. It is produced according to the process of Goldschmidt and Stock by electrolysis of a beryllium and barium fluoride mixture with a water-cooled iron cathode at about 1,300 deg. C. The melting point of the metal is above 1,285 deg., and it is this temperature that causes the difficulties of manufacture. The Siemens & Halske Company has undertaken to develop the process further.

The raw material used is the natural beryllium ore, occurring in numerous localities in appreciable quantities, which can be converted to the electrolytic salt. Electrolysis now produces pieces several pounds in weight and of very high purity. In America sodium beryllium chloride is electrolyzed at 200 deg. C. and the flaky metallic product is smelted in a subsequent process. Economically there seems to be little difference in the two methods. The price of the metal, to be produced in a new Siemens & Halske plant designed for one ton a year, will be 1 Mark (i.e. about 25 cents) a gram, until increased consumption and lower costs for the electrolytic salt (the primary factor) allow of a reduction.

THE pure metal, because of its great permeability, is suitable (17 times more so than aluminum) for the passage of short-wave radiations, such as X-rays and the like. Its hardness and price militate against its use as general structural material. In America one looks to satisfactory light alloys of beryllium and aluminum. In Germany attention is directed chiefly to alloying it with heavy metals, which thereupon show remarkable improvements. Bronzes of copper containing a few hundredths per cent of beryllium have a high electric conductivity and chemical resistance. Of especial interest is the fact that they can be worked cold and can be given a steely hardness on subsequent warming. They constitute an excellent structural material for severe chemical and mechanical service. Additions of 0.01 to 0.02 per cent of beryllium to a smelt of "electrical" copper are superior in many respects to the phosphorus that usually is employed for deoxidation. A future also awaits ferrous alloys containing beryllium.

Professor Ruff, Breslau, showed several ovens designed for high temperatures (up to 3,000 deg. C.) made of zirconium dioxide and mixtures of it with other earths. Another apparatus shown by him was used for the synthesis, fractionation and investigation of fluorides prepared by him; for example, nitrogen trifluoride and chlorine fluoride. Working on the fluorides of the iron and platinum, he was able to substantiate the existence of a higher rhodium fluoride.

A PRESENT controversy between importers of Chile nitrate and synthetic fertilizer producers involves, in part, the presence in Chile saltpeter of a small amount of iodine, absent in the artificial product. The former claim that it is this slight quantity which gives their product its beneficial influence on plants. On the other hand two papers by Dr. Griesbach, Wölfen, and Dr. Ströbel, Ludwigshafen, reported the results of investigations on the iodine cycle in crop soil, and the former found that only a minute fraction of the normal soil iodine content is utilized by the plant and that the ordinary precipitation from the air alone would yield an abundant supply. The fear of iodine deficiency in agricultural soils therefore may be regarded as ungrounded. Dr. Ströbel, in treating the topic of iodine as plant nutrient, came to the conclusion shared by most German investigators, that abnormal iodine content in soils will not affect the receptivity of plants unless it reaches very high and wholly impractical figures, far beyond the amount available in any commercial fertilizer.

Prof. Fritz Frank, Berlin, speaking of gases from lignite, narrated some of his efforts to produce high-value fuel gases from the carbonization of lignite. The procedure involved the conversion of distillate fumes into gases in a reaction tower packed with coke as a catalyst. A successful conversion of the reactive hydrocarbons, carbon dioxide, and steam yielded a gas of 3,900 to 4,300 cal., in quantities of about 700 cu.m. per ton. The addition of water, according to the temperature and condition of the coke, gave corresponding yields of light hydrocarbons, mostly of the benzol series. The precipitated tars were principally aromatic, also according to the condition of the glowing coke catalyst.

The sessions ended in a visit to the Upper Silesian industrial region, which, though in an obviously straitened economical position, is at the forefront of progress in the industrial exploitation of coal.

Report on Clinic Disaster by Army Board

A LENGTHY and complete report on the Cleveland (Ohio) Clinic disaster on May 15, described on page 334 of this issue, has been prepared by a board of officers and technologists representing the Army, Navy, and Chemical Warfare Service. Immediately after the fire Major General H. L. Gilchrist, chief of the Chemical Warfare Service, was ordered to Cleveland together with Commander D. C. Walton, M. C., to determine the cause of the fire and offer the assistance of the Service. The offer was accepted and a board was formed and assembled at Edgewood Arsenal on May 20.

About 4,000 lb. of nitrocellulose X-ray film was procured for experimental purposes. Investigation of this in large-scale apparatus built for the purpose established several facts and recommendations: (1) that film could be ignited by contact with any agent such as steam pipe or electric bulb which would raise the film temperature to as low a point as the boiling point of water for a considerable time; (2) proper sprinkling, venting, and isolation of a film storage room would reduce the hazard to reasonable proportions; (3) four types of commercial extinguishers were ineffective against film fires; (4) water only should be used for extinguishing film fires; (5) oxygen helmets rather than any of the existing types of canister masks should be employed in fighting film fires; (6) casualties at Cleveland were caused principally by nitrogen oxides and by carbon monoxide (no mention is made of HCN); (7) competent engineering advice should precede the construction of all X-ray storage rooms, while the regulations of the National Board of Fire Underwriters should be strictly observed.

Standard Oil of Indiana Loses Suit

IN A decision handed down on June 11 by the United States District Court at Chicago, the Standard Oil Company of Indiana and 51 associated companies were found guilty of violating the Sherman anti-trust act by pooling "oil cracking" processes. Three federal judges sat in the lawsuit and the majority opinion was signed by Judges Evan A. Evans and George T. Page. Judge A. D. Anderson dissented.

The decision grants the government a permanent injunction restraining the defendant companies from further violations of the law, and comes after more than four years of litigation. It is believed the decision will be appealed to the United States Supreme Court.

In the original suit, filed in 1925, the government charged that the defendants had conspired to restrain trade and create a monopoly by refusing independent concerns the right to use the patented Burton cracking process to extract gasoline from crude oil.

Supertaxes Retard Growth of French Chemical Industry

Multiple Sales Taxes Responsible for Rising Price Trend

From our Paris Correspondent

THE GENERAL situation in the French chemical trade is satisfactory though handicapped by excessive taxation. Supertaxation not only raises the cost of living but also increases the deficit of the home commercial balance. During the first three months of 1929 total value of imports over exports exceeded 3,270,000,000 francs, whereas the total value of imports over exports during the year 1928 was only 2,100,000,000 francs. Moreover, in 1928 the average ton was valued at 1,450 francs whereas in 1929 it has averaged 1,275 francs.

These figures clearly show that manufacturers and exporters have cut prices to keep business going, but they now declare that they have reached the limit of taxation. It stands to reason that if more rational duties were levied, more business could be done and the amount of fiscal duties gathered would increase accordingly. One of the most unpopular taxes is the sales duty on every transaction in the same goods, thus rapidly increasing prices. It is suggested that these multiple sales duties should be replaced by a single duty paid by the manufacturer.

Heavier custom duties also are responsible for a slump in business and in some cases the American custom tariff has considerably slackened Franco-American transactions.

We have already mentioned in a previous letter the business agreements drawn between the French and German manufacturers of the following chemical products: Nitrate, fertilizers, methanol, rayon, synthetic camphor, synthetic carburants and several other products less important. A tripartite agreement has been drawn between the French, German and Swiss chemical industries, the latter being the well-known Basle specialists in coloring matters and pharmaceutical products. This Continental union represents about 80 per cent of the output of coloring matters in Europe, thus making it a strong competitor of the British and American chemical trades in the world market.

FROM a strictly technical point of view there is no sensational novelty in the manufacturing of nitrogen, but commercially speaking the existing nitrogen works are growing more and more important. The following figures will give an idea of the steady development of this industry: In November, 1928, the daily output of synthetic ammonia of the Nitrogen Works of Toulouse was 20 tons, in December it was 27 tons and in January 37 tons. The output increases daily, for there is still a large margin between the present output and requirements.

The Toulouse Nitrogen Works uses the Casale process but will also use the German Haber process, a Haber system plant having been ordered and bought from Germany on the "Prestations" basis. This plant will cost 16,500,000 francs.

The synthetic ammonia industry has built or is actually building fourteen nitrogen works in France, most of which are already in working order. They use either the Claude or the Casale system, 18,000 tons of ammonia being manufactured by the Claude process and 16,000 tons by the Casale process. The 34,000 tons produced, however, was insufficient for home needs. In January, 1929, about 8,500 tons of sulphate of ammonia, worth 12,000,000 francs, was imported, which is considerably less than that imported during the same period last year, 11,500 tons came from other countries.

In order to develop this new-born industry the manufacturers claim protection and demand higher custom duties on foreign nitrates. Agricultural France, which is a power in the country and a large consumer of foreign nitrates (mostly of German sulphate and Chilean nitrate), strongly opposes these claims. So far the government has not taken steps one way or another, though fully aware that a home nitrogen industry undoubtedly is an asset for home defense.

Donat Agache, president of the Kuhlmann Company, died recently, aged 47. He was the grandson of Frederick Kuhlmann, who founded the well known firm of Kuhlmann's in 1825 with a working capital of 200,000 gold francs. R. P. Duchemin, well known in industrial and chemical circles, has been appointed president of the company.

News in Brief

ARRANGEMENTS are being made for the first showing of the American Factory and Industrial Production Exposition to be held in Chicago in the early part of 1930. The National Factory Show, as it will be called, will be a horizontal exposition covering numerous and varied types of equipment for use in factory operation as well as a great number of advanced ideas entering into factory construction and production problems.

A SHORT COURSE in gas engineering will be held at the University of Illinois under the auspices of the Illinois Gas Association, from June 17

to 29, inclusive. Among the professors and instructors who will be present to conduct the work are the following: Prof. W. Trinks, mechanical engineering department, Carnegie Institute; E. G. de Coriolis, Surface Combustion Company, New York; R. G. Guthrie, vice-president, American Society for Steel Treating; William A. Darrah, Continental Industrial Engineers, Inc.; and Dr. T. E. Layng, University of Illinois.

AT THE ANNUAL MEETING this year of the Association of German Lacquer Manufacturers of Berlin it was decided to follow American example and promote a "save-the-surface" campaign. The association has been in existence for 30 years but has never engaged in promotional work of this character. The meeting disclosed that the value of lacquer production in Germany is 250,000,000 to 300,000,000 marks annually from raw materials costing 150,000,000 marks.

THE MONSANTO CHEMICAL WORKS has concluded arrangements for the acquisition of the Rubber Service Laboratories Company and its subsidiary, the Elko Chemical Company. The Rubber Service Laboratories Company was established in 1922, pioneering in the field of rubber accelerators. The company has rapidly expanded and the number of rubber chemicals it is now manufacturing approximates twenty. Through the Elko subsidiary, which was established a few years ago, the company manufactures a number of important organic chemicals for the pharmaceutical and dyestuff fields, as well as general industrial use.

LAST YEAR the rag-content paper manufacturers sent two research associates to the Bureau of Standards to work on fundamental research problems connected with the permanence of high-grade papers. As an outgrowth of that work, these manufacturers have now opened a well equipped paper research laboratory at 44 Vernon Street, Springfield, Mass. This laboratory will specialize in the study of fundamental problems relating to the industry, giving particular attention to the new developments in the chemistry of cellulose and the extension of chemical control in the manufacture of high grade papers for permanent records. The laboratory is in charge of Dr. Jessie E. Minor.

AT A SPECIAL MEETING of the Rubber Association of America, Inc., held at New York last month, the name of the association was changed to the Rubber Manufacturers Association, Inc., and membership was limited to firms, corporations and individuals directly engaged in the manufacture of rubber products in the United States. At a special meeting of the Rubber Institute, Inc., it was voted to dissolve the institute and to turn over to the Rubber Manufacturers Association, Inc., the unfinished business of the institute as at the time of dissolution. The action of both organizations was taken as the final step in merging the interests of the two,

MEN in Chemical Engineering

CLAUDE S. HUDSON, recipient of the Willard Gibbs Medal for 1929, received the official presentation on May 24 at a reception held by the Chicago Section of the American Chemical Society at the Palmer House. Dr. Hudson was chosen for the award because of his distinguished work on carbohydrate sugars carried on in his past twenty years with the government, where he is now chief of chemistry of the U. S. Public Health Service. The presentation was made by Dr. William Lloyd Evans, who only three months before had received the Nichols Medal from Dr. Hudson.

F. C. FRARY, director of research of the Aluminum Company of America, was elected president of the American Electrochemical Society at its annual meeting in Toronto on May 29. Dr. Frary has filled his present post with the Aluminum Company since 1919, when he came there fresh from work in the Chemical Warfare Service. At that time his outstanding achievements were the invention, with Dr. S. Temple,



F. C. FRARY

of "Frary" metal, and the development, with Major D. J. Demorest, of the largest phosgene plant in the world. Dr. Frary began his career, after graduation from the University of Minnesota in 1905, with ten years' teaching experience at the same school.

H. SPEIGHT has been promoted to section engineer in charge of electrochemical work in the general engineering department of the Westinghouse Company at East Pittsburgh, Pa.

ARTHUR W. GRAY, formerly with the L. D. Caulk Company and Dielectric Products, Inc., has joined the Brown Instrument Company as associate director of research. Dr. Gray has done important work for the Bureau of Standards, especially in the line of methods and apparatus.

MARCUS T. LOTHROP has been elected president of the Timken Roller Bearing Company, succeeding H. H. Timken, who has become chairman of the board and with whom he has been closely associated for many years. Mr. Lothrop began as metallurgist with his firm in 1911, and prior to the present election had been vice-president and general manager in charge of all operations and sales.

RALPH R. MATTHEWS, for many years chairman of the petroleum division of the American Chemical Society and associated with the Shell Company in St. Louis, is now vice-president in charge of sales of the Battenfeld Grease & Oil Company, Kansas City, Mo.

REIMAN G. ERWIN, until recently a chemical engineer in the research department of the Vacuum Oil Company, has joined the design division of the duPont company, where he will be engaged in chemical plant design in connection with the dye works.

D. W. WILSON has resigned his position as vice-president of Dry Quenching Equipment Corporation to accept a position in charge of engineering work with M. W. Kellogg Company. Mr. Wilson is beginning his new work, with headquarters at Jersey City, during June.

SAMUEL TOUR, for several years metallurgical engineer for the Doehler Die Casting Company, Batavia, N. Y., has been appointed vice-president and chemical and metallurgical engineer for the firm of Lucius Pitkin, Inc., of New York City. He will be in Batavia, in direct charge of special research work on metals and alloys.

JOHN FRANKLIN DODGE, fuel oil engineer of the Standard Oil Company of California and an authority on gas conservation, has been named professor of petroleum engineering in the College of Engineering of the University of Southern California, where he will take up his duties in September.

JAMES H. MCGRAW, chairman of the board of the McGraw-Hill Publishing Company and publisher of *Chem. & Met.*, was the recipient of the honorary degree Doctor of Commercial Science from New York University at its commencement exercises on June 12. Dr. William H. Nichols, chairman of the board of the Allied Chemical & Dye Corporation, conferred the degree, citing Dr. McGraw for a notable career which, in the form of private commercial life, has nevertheless become a force in engineering education.

CHARLES E. MUNROE, chief explosives chemist of the U. S. Bureau of Mines, was guest of honor at a luncheon given in Washington on May 23 by his associates and close friends in recognition of his eightieth birthday. A bronze medal, bearing his portrait, was pre-



CHARLES E. MUNROE

sented to Dr. Munroe, a feature of the gift being that its delineation had been produced by the "Munroe effect" of detonation by an explosive. O. P. Hood, acting director of the Bureau of Mines, presided at a gathering well designed to give intimate recognition to a long career of achievement in the field of explosives and invention.

HARRY HODGSON of Athens, Ga., formerly president of the Old Southern Fertilizer Association, was elected president of the Interstate Cotton Seed Crushers' Association at New Orleans on May 16.

CALENDAR OF FORTHCOMING EVENTS

AMERICAN CHEMICAL SOCIETY, 78th meeting, Minneapolis, Sept. 9-13.

AMERICAN ELECTROCHEMICAL SOCIETY, fall meeting, Pittsburgh, Sept. 18-20.

AMERICAN GAS ASSOCIATION, annual meeting, Atlantic City, Oct. 14-18.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, mid-year meeting, Philadelphia, June 19-21; June 22, conference on chemical engineering education.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, June 24-28.

NATIONAL METAL CONGRESS, held in conjunction with metal societies, Cleveland, Sept. 9-13.

RUBBER SECTION, AMERICAN CHEMICAL SOCIETY, fall meeting, New York, Sept. 26-28.

SEVENTH COLLOID SYMPOSIUM, Baltimore, Md., June 20-22.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, fall meeting, Sept. 24-26, Richmond; Sept. 27, Washington, D. C.

A. D. CAMP, who for the past three years has been on the staff of the Aluminum Company of America, has joined the carbon sales division of the National Carbon Company, thus returning to a field in which he had been technically engaged for many years in the past.

HUGH D. MCLEESE, formerly New York sales representative of the United Chromium Corporation, is now sales manager for his firm in Detroit.

STEPHEN S. TUTHILL has resigned his post as secretary of the American Zinc Institute, to take effect on Aug. 1.

A. L. STERN, who for ten years has been with the Max Marx Color & Chemical Company, Irvington, N. J., as vice-president and director, is now New England representative of the Pulverizing Machinery Company, of Elizabeth, N. J.

J. V. N. DORR sailed for Europe on the "Caronia" on May 24 for a prospective visit of about three months, which he will devote in part to the European interests of the Dorr Company.

G. A. LANDRY has been promoted to superintendent of development of the Western Electric Company at Hawthorne, Ill.

LESTER KIRSCHBRAUN, director of research for the Flintkote Corporation at East Rutherford, N. J., was recently made a vice-president.

M. E. OGLESBY, formerly assistant chief chemist of the Chemical Warfare Service, Edgewood, Md., has assumed the duties of director of the chemical department for the Behr-Manning Corporation, Troy, N. Y.

OBITUARY

JOHN CALDER HEBDEN, after an illness lasting six weeks, died on June 3 at Providence, R. I., where he was stricken during a business trip. Mr. Hebden, who was an inventor and an authority on explosives, was vice-president and general manager of the Dyeing Processes Corporation and vice-president of the Hebden Sugar Process Corporation at the time of his death. He was born in Colgate, Wis., in 1862 and after his primary schooling was graduated from Brown University in 1885, where he later spent several post-graduate years. His technical career included work for William J. Matheson & Company, Cassella Color Company, A. Klipstein & Company, and the Franklin Process Company, an outstanding accomplishment of this period being his co-invention of the Franklin dyeing process. During the War he made several official investigations on explosives and supervised the manufacture of high explosives for the Ordnance Department.

HENRY A. ROSS, president of the Ross-Tacony Crucible Company, Philadelphia, died on May 10 at his home in that city. He was 63 years old and had succeeded to the head of the business at the death of his father in 1898.

HENRY W. BLAKE, for thirty-eight years active as a technical editor for the McGraw-Hill Publishing Company and its predecessors, died on May 20 at his home in Englewood, N. J., at the age of 63. Mr. Blake was a native of New Haven and received his A.B. degree at Yale in 1886, subsequently taking a course in electrical engineering at the Massachusetts Institute of Technology. Following a few years of industrial work, he joined his technical training to an editorial career in 1891 with the young McGraw company, which not very long afterward helped in launching *Chem. & Met.* His electrical knowledge having directed his path to the *Street Railway Journal*, he became its editor within three years and continued active in the upbuilding of the subsequent *Electric Railway Journal* almost until the time of his death.

ERNST TWITCHELL, long prominent in the chemical technology of fats and soaps, died at his home in Cincinnati on June 6. He was a native of Wyoming, Ohio, and had reached his 66th year. Dr. Twitchell was perhaps best known for the process bearing his name, which

utilized an "artificial ferment" (consisting of oleic acid in naphthalene solution acted on by sulphuric acid) for the catalytic hydrolysis of fats. This process, with occasional modifications, has found extended use in the American soap industry. Among his activities at the time of his death he was technical director of the Emery Candle Company and chairman of the board of the Twitchell Process Company.

WILLIAM S. HALLOWELL, for many years an officer of the Cochrane Corporation, died in Germantown, Pa., on June 2. He had been active in the introduction of various heating equipment and was later secretary and treasurer of his company.

JAMES W. FULLER, president of the Fuller Company, the Allentown Portland Cement Company, and the Valley Forge Cement Company, died on April 4 in San Francisco at the age of 56. Until its sale in 1926 he was president of the Fuller-Lehigh Company, after which he founded the Fuller Company for the special development of materials conveying.

INDUSTRIAL NOTES

THE JOHNS-MANVILLE CORPORATION has moved its Western division headquarters to 230 North Michigan Avenue, Chicago, and its Milwaukee office to 97 East Wisconsin Avenue.

PENNSYLVANIA PUMP & COMPRESSOR COMPANY has appointed Carpenter & Byrne, 4 Smithfield Street, representative for Pittsburgh and Wells Fargo & Company, Express, agent for all Mexico.

THE PRESSED STEEL TANK COMPANY, Milwaukee, has acquired the assets of the Seamless Steel Products Corporation, of the same city.

UNION CARBIDE & CARBON CORPORATION has moved its Central division to its new Carbide & Carbon Building, at Michigan and South Water Street, Chicago.

JEFFREY MANUFACTURING COMPANY, Columbus, announces the incorporation of the Jeffrey Manufacturing Company, Ltd., with headquarters at Montreal, a branch office at Toronto and warehouse at Calgary, Alberta.

SOUTHERN MANGANESE STEEL COMPANY, St. Louis, now has its Pittsburgh office in enlarged quarters in the Koppers Building.

QUIGLEY FURNACE SPECIALTIES COMPANY has moved its headquarters to the Lakner Building, 56 West 45th Street, New York.

BIGGS BOILER WORKS has changed its New York offices to 50 Church Street.

THE VITALITE COMPANY has been formed as a joint subsidiary of the Celluloid Corporation, Newark, N. J., and the New York Wire Cloth Company, New York, for the manufacture of wire cloth coated with cellulose acetate.

TOLHURST MACHINE WORKS, Troy, N. Y., has moved its New York office to 30 Church Street and placed W. T. Powers in charge.

THE PACIFIC COAST BORAX COMPANY has moved its New York offices from 100 William Street to 51 Madison Avenue.

FOOTE BROS. GEAR & MACHINE COMPANY is transferring its entire general office in Chicago to 111 North Canal Street.

GARFIELD FIRE CLAY COMPANY, Bolivar, Pa., has changed its Eastern sales office to 1010 Harrison Building, Philadelphia, with H. I. Robinson and D. J. Matheson in charge.

HARRISON-WALKER REFRACTORIES COMPANY has made the following new elections: Kenneth Seaver and Raymond Willey, vice-presidents; W. B. Coullie, sales manager, and G. G. Coolidge, assistant to the president.

CHADELOID CHEMICAL COMPANY is now located at 75 East 45th Street, New York.

FUSION WELDING CORPORATION, Chicago, has appointed F. O. Weber sales manager for the Pittsburgh district with offices at 229 Boulevard des Allies.

BROWN INSTRUMENT COMPANY now has its Boston offices installed at the Public Service Building, 89 Broad Street.

ARLINGTON CHEMICAL COMPANY, South Washington, Va., has been incorporated for trade in chemicals and is led by B. R. Welford, president; John Howard, vice-president; J. M. Welford, secretary.

CENTURY ELECTRIC COMPANY, St. Louis, has purchased Roth Brothers & Company, Chicago, which will henceforth be operated as a division.

NORTH AMERICAN REFRACTORIES COMPANY has been formed as a consolidation of Ashland Fire Brick Company, Crescent Refractories Company, Dover Fire Brick Company, Elk Fire Brick Company, Farber Fire Brick Company, and Queens Run Refractories Company. Its general offices are at the National City Bank Building, Cleveland.

THE CARBORUNDUM COMPANY, Niagara Falls, N. Y., has made the following appointments: C. J. Steuber, manager at Detroit; H. E. Kerwin, manager at Milwaukee; R. Ralnin, manager at Chicago; G. Harden, manager for Germany.

PATTERSON FOUNDRY & MACHINE COMPANY, East Liverpool, Ohio, has formed a subsidiary, the Patterson Steel Products Company, for the manufacture of welded steel products.

CHEMICOLOR LABORATORIES are now located at 90 West Street, New York.

SCHWAB LABORATORIES, INC., are now situated at 202 East 44th Street, New York.

MONSANTO CHEMICAL WORKS, St. Louis, have acquired the Rubber Service Laboratories Company, Akron, Ohio, and the latter's subsidiary, Elks Chemical Company.

YBOMANS BROTHERS COMPANY, Chicago, is now represented by the Capitol Equipment Company, Bank of Commerce Building, Charleston, W. Va.

ROESSLER & HASSLACHER CHEMICAL COMPANY has moved to 10 East 40th Street, New York.

GOSLIN-BIRMINGHAM COMPANY is the name of the recent consolidation of the Joubert & Goslin Machinery Company and the Birmingham Foundry & Machine Company, both of Birmingham, Ala. Julius Goslin is president and G. W. Morrow vice-president of the organization.

HERCULES POWDER COMPANY, Wilmington, Del., has taken over the business and assets of the Virginia Cellulose Company and will operate it as the Virginia Cellulose department with the same personnel.

GENERAL REFRACTORIES COMPANY has changed its Cleveland office to 1126 Leader Building, and its Buffalo office to 1210 Genesee Building.

FOOTE BROS. GEAR & MACHINE COMPANY has appointed S. H. Elsenberg representative for the Southwest with headquarters at 2812 Ash St., Denver, Colo.

ECONOMIC INFLUENCES

on production and consumption of CHEMICALS

Manufacturing Operations Highest on Record in May

Activities in Chemical Industry Surpass Those of Last Year

GENERAL manufacturing operations in the United States in May, corrected for seasonal variation, and based on consumption of electrical energy, were the highest on record, surpassing the previous high monthly rate, which occurred in April, by 3.3 per cent, according to statistics compiled by *Electrical World*. Sustained activity in iron and steel plants, the rubber manufacturing industry, and improvement in the textile situation accounted for the gains made.

The May rate of operations, not corrected for seasonal variation, was 0.4 per cent above April of this year, but was 2.6 per cent under the peak of general productive operations established in February. Manufacturing operations for May of the current year were on a plane that was fully 15 per cent above May of last year. The first five months of 1929 witnessed an average rate of activity that was 13.2 per cent greater than in the corresponding period last year.

With the exception of leather products, and paper and pulp, all industries recorded a substantial increase over May of last year. The largest gain over last year, and a record rate of activity, was reported by the rolling mills and steel plants, the increase amounting to 37.8 per cent.

Manufacturing activity in the United States in May, as compared with April, 1929, and May, 1928, all figures adjusted to 26 working days and based on consumption of electrical energy (monthly average 1923-25 equals 100), follows:

	May 1929	April 1929	May 1928
All industrial groups.....	136.9	136.4	119.0
Metal industries group.....	154.8	149.9	123.6
Rolling mills and steel pits.....	172.2	153.3	125.0
Metal working plants.....	144.2	148.3	122.7
Leather and its products.....	95.2	82.0	98.1
Textiles.....	129.9	128.1	105.7
Forest products.....	111.1	108.0	110.8
Automobiles and parts.....	161.8	170.6	141.6
Stone, clay and glass.....	143.5	145.0	129.3
Paper and pulp.....	129.9	136.0	136.4
Rubber and its products.....	157.6	155.7	128.5
Chemicals and allied prod.....	129.2	131.7	126.3
Food and kindred products.....	122.6	121.2	103.9
Shipbuilding.....	135.2	116.1	84.0

Latest data on export trade in chemicals and related products cover the month of April. Outward shipments in that month were valued at \$12,596,160 as compared with \$10,395,041 for April, 1928. The industrial chemical group carried a good part of this increase with the soda compounds reporting an increase in quantity of more than 56 per cent as compared with April, last year. Paints, pigments, and varnishes like-

wise show a favorable comparison and the same is true for fertilizers and fertilizer materials.

DEFINITE figures of production in April are available for some of the manufacturing industries which are large consumers of chemicals. These figures clearly indicate an increase in manufacturing operations as compared with April, 1928. Automobile manufacture has opened up a wide outlet for chemicals and for products into which chemicals enter. In April the domestic output of passenger cars exceeded that for April, 1928, by more than 47 per cent and an increase of more than 81 per cent was recorded in the output of trucks in the same relative periods. It is evident, therefore, that the automobile industry has been a material factor in stimulating production and consumption of chemicals so far this year.

While the progress of rayon production cannot be traced in absolute terms, all reports agree that the output has been running consistently above that reported for the corresponding period of last year. Different branches of the glass industry have enlarged their activities over the standards set last year. The

Larger Sales of Lithopone and Lead Pigments

THERE were increases in the sales of all of the lead pigments in 1928 with the exception of white lead ground in oil and orange mineral, according to a report from the U. S. Bureau of Mines, in the face of substantial decreases in the average values of all lead pigments.

The sales of zinc pigments and salts were generally higher in 1928, with a notable increase in the sales of lithopone to a new high record, 200,468 short tons. The sales of lithopone were dis-

tributed as follows: for paint, varnish and lacquers, 149,122 tons; for floor coverings and textiles, 35,416 tons; for rubber, 6,898 tons, and for other uses, 9,032 tons. The lithopone producers report an annual productive capacity of 227,000 tons. Comparative figures for 1927 are: for paint, varnish and lacquers, 131,145 tons; for floor coverings and textiles, 31,186 tons; for rubber, 7,653 tons, and for other uses, 7,010 tons. The annual capacity reported for 1927 was 202,000 tons.

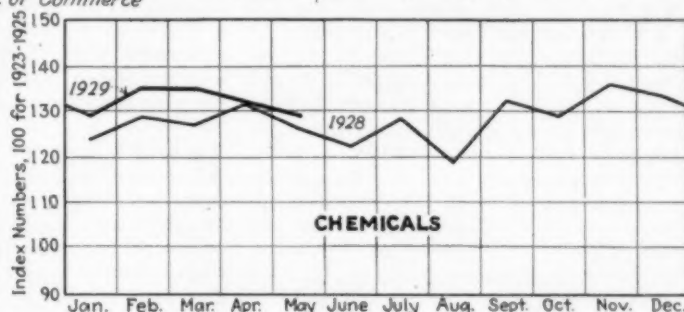
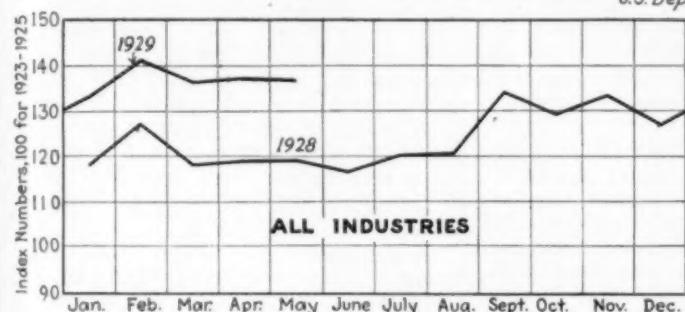
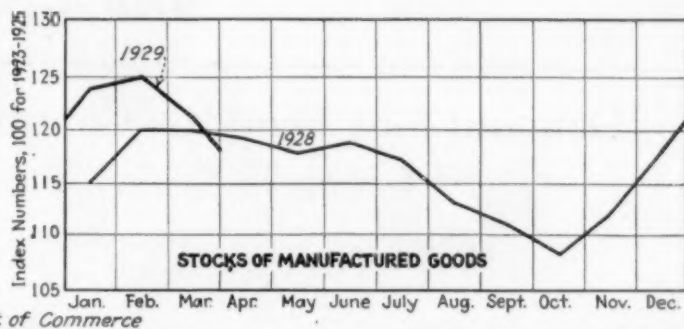
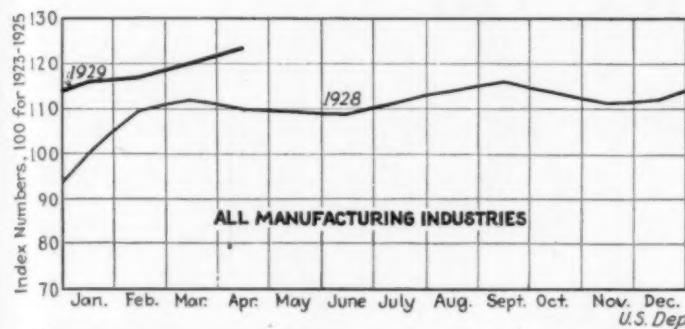
The prices for zinc pigments and salts were \$1 to \$2 a ton lower than in 1927.

Production	April 1928	April 1929
Acetate of lime, 1,000 lb.....	11,693	11,787
Methanol crude, gal.....	657,253	731,811
Methanol, ref., gal.....	468,446	502,010
Turpentine, wood, bbl.....	6,052	6,917
Rosin, wood, bbl.....	34,831	26,150
Turpentine, gum, receipts, bbl.....	20,765	31,610
Rosin, gum, receipts, bbl.....	67,762	100,454
Byproduct coke, 1,000 tons.....	3,925	4,457
Plate glass, 1,000 sq.ft.....	10,560	12,534
Glass containers, 1,000 gross.....	2,421	2,519
Superphosphate, ton.....	210,780	357,550
Chemical wood pulp, ton.....	210,780	233,630
Automobiles		
Passenger cars, no.....	364,877	538,679
Trucks, no.....	45,227	81,977
Petroleum refined, 1,000 bbl.....	72,988	80,459
Consumption		
Cottonseed oil, bbl.....	279,680	288,900
Cotton, bales.....	524,765	631,710
Wool, grease equiv, 1,000 lb.....	38,855	49,205

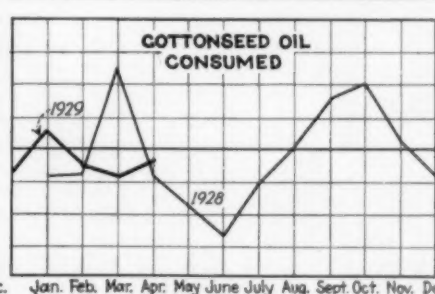
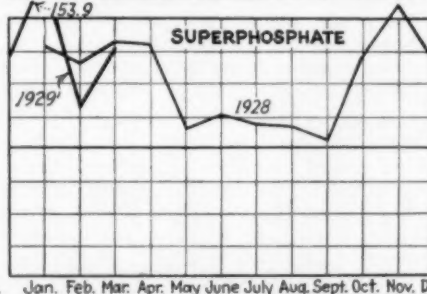
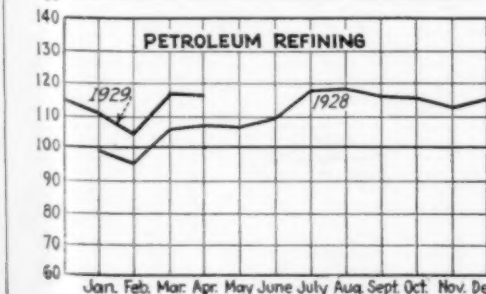
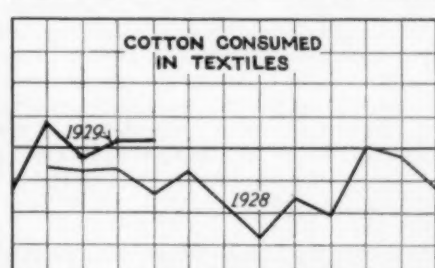
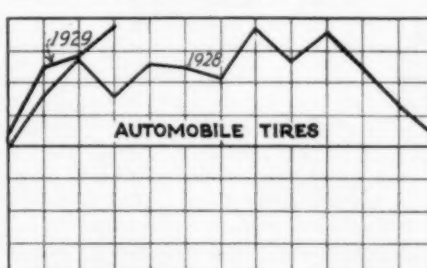
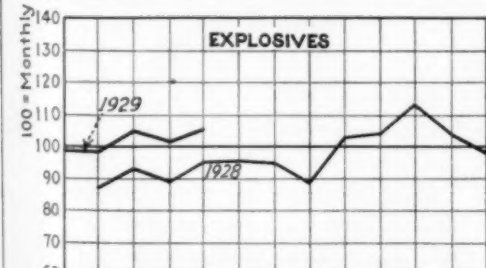
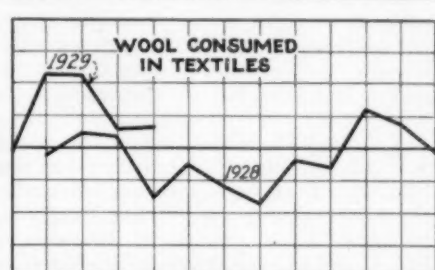
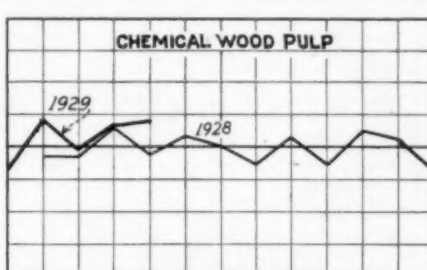
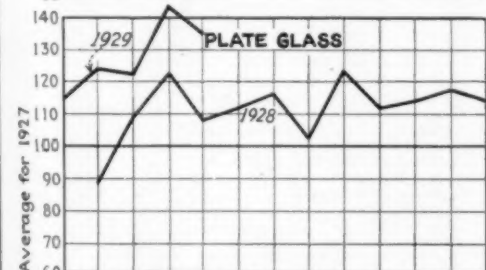
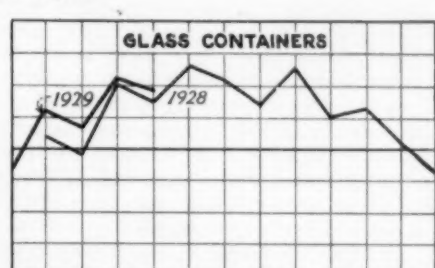
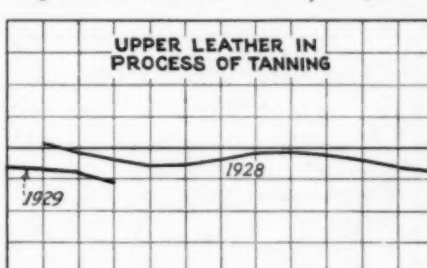
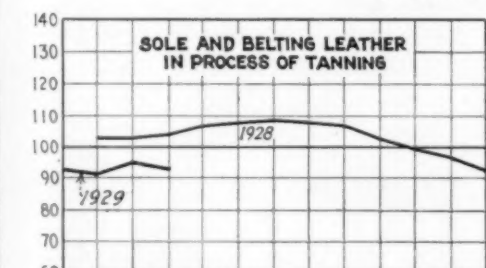
Lead and Zinc Pigments and Zinc Salts Sold by Domestic Manufacturers in the United States, 1927-28

	1927		1928	
	Short Tons	Value	Short Tons	Value
Basic lead sulphate or sublimed lead:				
White.....	13,482	\$2,027,333	16,002	\$2,211,470
Blue.....	1,061	168,416	366	50,890
Red lead.....	39,073	6,980,042	40,497	6,816,876
Orange mineral.....	709	178,457	459	112,521
Litharge.....	81,655	13,064,046	85,570	12,872,730
White lead:				
Dry.....	38,669	6,767,385	42,049	6,688,115
In oil.....	119,026	27,770,000	111,923	24,553,989
Zinc oxide.....	151,246	19,997,212	160,904	20,685,442
Lensed zinc oxide.....	26,064	3,193,014	24,223	2,945,323
Lithopone.....	176,994	17,163,620	200,468	19,073,914
Zinc chloride, 50° Baume.....	36,096	1,640,446	38,837	1,706,222
Zinc sulphate.....	3,211	185,865	2,293	132,235

ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES



Productive activity based on electrical consumption, *Electrical World*



MARKET CONDITIONS and PRICE TRENDS

Demand for Chemicals Continues on Active Scale

Falling Off in Buying Interest Reported
Less Than Normal

WHILE new orders reaching the market have shown a tendency to decline, the market for chemicals to date has presented an active appearance and seasonal influences have retarded buying less than usual. Some of the important heavy chemicals were reported to be in rather large supply a few weeks ago due to the withholding of shipping instructions against contracts but buying on new account was unexpectedly heavy and readily absorbed holdings in producers' possession.

As a rule holders of contracts have been ordering deliveries regularly and the steady flow of materials from producer to consumer has been, and still is, the feature of the market.

In the spot market there has been an important call for arsenic and calcium arsenate. Boll weevil emergence in the cotton-growing states has caused fears of heavy damage and an opportunity has been given to reduce holdings of calcium arsenate stored at consuming centers in the South. Demand for copper sulphate, which has been late in asserting itself, has increased in a satisfactory manner and a large business was reported since the turn of the month.

ONE of the most important recent developments in the market was the offering of domestic nitrate of soda. The development of a home synthetic industry marks the first competition which the Chilean material has met in our markets. The effect of domestic offerings on the market is not yet apparent but it can hardly fail to cut in on consumption of natural nitrate with price considerations possibly dictating the volume of sales. Production of nitrate in Chile is holding up well with the April output of 271,200 metric tons surpassing that for April, 1928, when the total was 255,100 metric tons. In the first quarter of the year Chile produced 809,078 metric tons of nitrate and shipped 993,153 metric tons. There were 69 oficinas in operation at the end of the quarter.

The low prices which have been in effect for sal ammoniac as a result of keen competition between domestic and foreign producers has failed to cut down arrivals from abroad. In fact the import figures for the last three months would indicate that foreign-made material was gaining in favor. Imports for the first four months of this year

amounted to 3,473,535 lb. with an average value of 3.226c. per pound as compared with 3,458,532 lb. with an average value of 3.09c. per pound for the corresponding period of last year.

RECENT reports from Chile to the effect that a large supply of sulphur had been discovered in that country brought out discussion regarding the possibility of increasing competition for that product. Later it was stated that the deposit was not important enough to become a market factor and that earlier statements had been exaggerated.

Domestic Production of Coal-Tar Crudes

The Tariff Commission has just issued the following table showing the production and value of coal-tar crudes in 1928 by firms not primarily engaged in the operation of coke-oven plants and gas houses.

Product	Production	Value
Carbolic oil or middle oil.....gal.	200,899	\$26,455
Dead or creosote oil.....gal.	134,460,126	17,507,588
Naphthalene, crude ¹ lb.	46,157,425	531,752
Other distillates.....gal.	6,709,519	1,005,972
Pitch of tar ².....tons	514,902	8,425,461
Refined tars.....bbl.	1,640,282	7,543,457
Solvent naphtha ³.....gal.	6,676,656	1,437,518

¹Includes 12,386,000 gallons of dead oil produced in byproduct coke plants.

²Includes 12,182,143 lb. of crude and refined, produced in byproduct coke plants.

³Does not include 54,131 tons produced in byproduct coke plants.

⁴Includes 5,587,370 gallons of solvent naphtha produced in byproduct coke plants.

A report from Vice-Consul Schoenrich says that in recent years the mining industry in Chile has been producing around 6,000 metric tons of sulphur annually, practically all of which is used in south-central Chile. The year 1928 was a very favorable one for this industry, the national demand for sulphur being unusually strong. Local operators had hoped to produce 8,000 tons but found at the end of the year that it was below 7,000 in consequence of a shortage of Bolivian Indian labor, caused by unsettled conditions in Bolivia.

ONE of the crushers of linseed has called attention to the fact that stocks of linseed oil on hand March 31, 1929, were 24,191,812 gal. or lower than the stocks at this date for the past

three years. Last year there were nearly 32,000,000 gal. on hand at this date. The production during the first three months of the year was 26,683,036 gal. compared with nearly 30,000,000 for the same period last year. This gives a consumption for the first quarter of this year of 23,553,000 gal. compared with the record consumption for this same three months' period of last year of 23,981,275 gal. This makes consumption for the first six months of this present crop year 46,194,730 gal. compared with consumption for the same period of our last crop year of 45,557,239 gal. Consumption of linseed oil in this country from Sept. 1, 1928, to March 31, 1929, therefore has established a new record.

The increase in import duty in flaxseed as recently announced in a presidential proclamation in accordance with the flexible provisions of the tariff act has given strength to values for linseed oil and higher prices have prevailed in the last month.

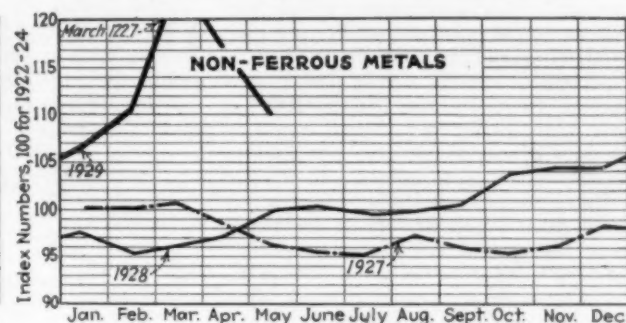
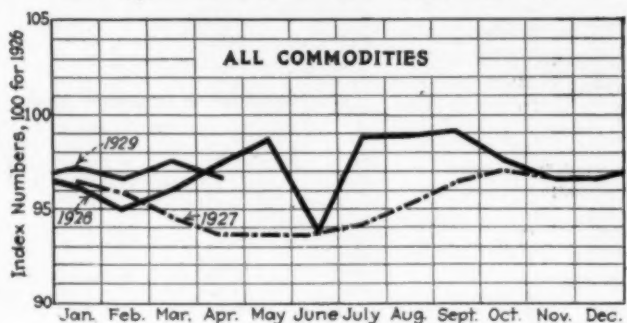
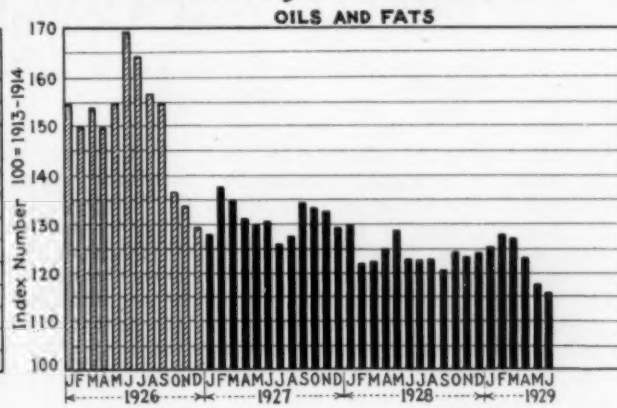
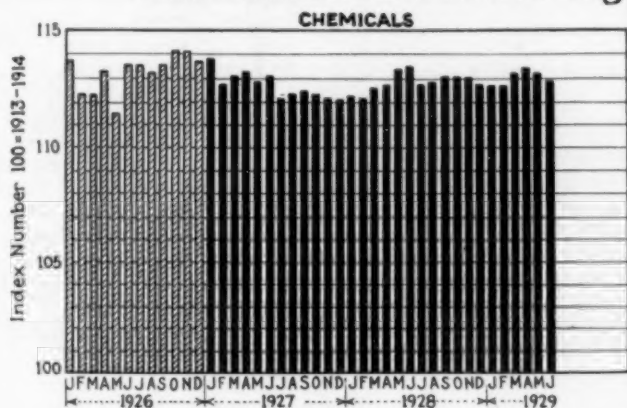
Exports of Chemicals

	April, 1928	April, 1929
Benzol, gal.....	981,612	434,209
Acid sulphuric, lb.....	842,460	634,95
Acid borie, lb.....	387,211	510,78 ³
Other acids, lb.....	875,403	1,639,127
Methanol, gal.....	59,244	57,134
Glycerin, lb.....	291,947	245,027
Acetone, lb.....	445,860	804,836
Formaldehyde, lb.....	255,364	218,158
Ammonium compounds, lb.....	67,131	73,422
Aluminum sulphate, lb.....	4,318,265	4,796,696
Acetate of lime, lb.....	916,961	447,538
Calcium carbide, lb.....	251,143	493,512
Bleaching powder, lb.....	1,810,428	578,378
Copper sulphate, lb.....	527,573	271,189
Potassium compounds, lb.....	243,834	357,970
Sodium bichromate, lb.....	854,362	146,411
Sodium cyanide, lb.....	43,921	11,298,446
Borax, lb.....	7,923,393	8,221,908
Sodium carbonate, lb.....	5,178,979	6,031,701
Sodium silicate, lb.....	4,805,350	10,025,191
Caustic soda, lb.....	7,299,258	17,500,763
Other sodas, lb.....	7,803,742	11,169
Sulphate of ammonia, ton.....	6,235	67,569
Sulphur, ton.....	48,851	

Imports of Chemicals

	April, 1928	April, 1929
Dead or creosote oil, gal.....	3,618,837	7,483,466
Pyridine, lb.....		371,672
Coal-tar acids, lb.....	191,411	247,445
Coal-tar intermediates, lb.....	127,547	1,797,186
Arsenic white, lb.....	2,836,044	2,212,619
Acid acetic, lb.....		188,121
Acid formic, lb.....	179,796	48,542
Acid oxalic, lb.....	62,541	240
Acid sulphuric, lb.....	1,125,600	133,728
Acid tartaric, lb.....	203,259	1,228,084
Ammonium chloride, lb.....	905,728	698,816
Ammonium nitrate, lb.....	1,368,084	1,272,802
Barium compounds, lb.....	4,127,782	500,580
Calcium carbide, lb.....	230,500	42,315
Cobalt oxide, lb.....	33,365	212,027
Copper sulphate, lb.....	84,540	361,743
Bleaching powder, lb.....	367,062	1,264,530
Glycerin, crude, lb.....	66,120	853,848
Glycerin, ref., lb.....	14,727	56,314
Iodine, lb.....	77,301	2,238,546
Magnesium compounds, lb.....	1,703,639	8,864
Potassium cyanide, lb.....	2,965	2,086,615
Potassium carbonate, lb.....	1,686,397	1,247,182
Caustic potash, lb.....	1,065,384	117,289
Cream of tartar, lb.....		1,419,772
Potassium chlorate, lb.....	1,161,228	3,510,451
Sodium cyanide, lb.....	2,435,372	165,491
Sodium ferrocyanide, lb.....	408,009	22,500
Sodium nitrite, lb.....	5,599	119,620
Sodium nitrate, ton.....	131,819	4,842
Sulphate of ammonia, ton.....		127

CHEM. & MET. *Weighted Indexes of* PRICES



U. S. Dep't of Labor

Engineering & Mining Journal

Seasonal Conditions Awaited as Factors in Chemical Prices

WITH hearings on the chemical schedule now being held before the Senate Finance Committee and the passage of the new tariff schedule promising to be deferred, the market is looking to seasonal influences as the most immediate factor in bringing about price changes for chemicals. During the hot weather period offerings of bleaching powder in past years have been made at concessions. The larger use of liquid chlorine and the curtailment of bleach production make such a contingency more remote this season.

More active buying of such materials as arsenic, calcium arsenate, and copper sulphate, in itself predicates firmer prices but the two former have shown an easy price tone and increased buying is expected to bring about no advances in sales schedules. Copper sulphate is influenced more by production costs

than by the activity of the market and any price revisions may be expected to conform with the movement of the metal market.

Denatured alcohol is established on a steady price basis for the present but distant positions will depend on the rate of duty assessed on blackstrap molasses, and the fact that the 2.19c. per gallon rate was rescinded in the House by no means makes it certain that the existing rate will be continued in the new tariff. An active fight promises to be conducted in the Senate for a higher duty. Incidentally reports have been heard in the last few weeks regarding the placement of molasses contracts with producers in Hawaii and possibly the Cuban product will find a competitor.

OF INTEREST to producers and consumers of cellulose acetate was a report of the last few days to the effect that one company had perfected a process which would lower considerably the cost of producing this chemical. Experimental work along those lines also is said to have made considerable progress in other directions and prospects are very favorable for a lowering in prices for cellulose acetate. Encouraging reports also are heard regarding the expansion of synthetic acetic acid production, which may have a similar effect on market values for that product.

Alkalies are under no particular

price influence at present. Production has been going ahead at a record rate but the movement from works is in proportion and there seems to be no danger of price cutting as a result of accumulations.

VEGETABLE oils and fats reached a lower average price level during the month. Cottonseed oil showed an easier tendency but reports of large boll weevil emergence had a strengthening effect on cotton and this extended to the oil market, with the result that earlier losses were recovered. Linseed oil closed slightly higher than a month ago and the higher import duty on seed undoubtedly will become a price factor in the oil market unless it is offset by an unusually large domestic crop of seed. Tallow and fats developed an easy tone during the period and this had some influence on the quotations for coconut and palm oils. This condition is expected to continue until surplus stocks have been reduced.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This month	112.90
Last month	113.24
June, 1928	113.06
June, 1927	112.83

Lower selling prices for sulphate of ammonia was principally responsible for a reduction in the weighted index number. The majority of chemicals held a steady price course. Denatured alcohol was automatically advanced in accordance with a previously announced schedule.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This month	115.82
Last month	117.61
June, 1928	122.76
June, 1927	128.38

Earlier declines in cottonseed oil were recovered at the end of the period and linseed oil sold at higher levels than last month. Despite this, the weighted number was lowered as a result of reduced selling prices for practically all the other vegetable oils and animal fats.

Tariff Discussions Stress Importance of Industrial Alcohol

Synthetic Production Looms as Future Competitor of Distillation

CONTROVERSIAL discussions on the status of blackstrap molasses in the new tariff schedule apparently have directed the attention of legislators to the important place which commercial alcohol holds in the industrial fabric of the nation. As the tariff schedule came out of the Ways and Means Committee it proposed a duty of 2.19c. per gallon on molasses imported for distilling. In the House, farm interests, in an attempt to increase corn-distillation, asked that molasses be held dutiable at 8c. per gallon. Producers and consumers of alcohol protested against the 2c. per gallon proposed duty and the bill passed the House with molasses carrying a scheduled duty of one-sixth cent per gallon.

In the discussion before the House on the relative merits of producing alcohol from grain and from molasses, it was stated that the molasses-alcohol plants are located on the coast; the principal plants are at or near Boston, New York, Philadelphia, Baltimore, New Orleans and San Francisco.

IT WAS further stated that the four leading states producing alcohol from molasses, in order of their importance, follow: Louisiana, Maryland, Pennsylvania, and New Jersey. The molasses-alcohol industry is equipped, organized and located for the use of molasses as a raw material for the manufacture of alcohol. The three large grain-alcohol plants now operating are located at Pekin, Ill., Laurenceburg, Ind., and Cincinnati, Ohio. The annual grain-alcohol capacity of these three plants is about 15,000,000 wine gal., equivalent to about 6,250,000 bu. of corn per year. The production of these plants is estimated at less than 5,000,000 gal. per year, equivalent to about 2,800,000 bu. of corn. In addition there is one idle plant at Peoria with a reported capacity of about 4,000,000 wine gal.

Two plants—one at Peoria, Ill., and the other at Terre Haute, Ind.—manufacture butyl alcohol from corn. Each bushel of corn yields about 10 lb. of solvents, namely, butyl alcohol, acetone, and ethyl alcohol, in the ratio 6:3:1. The Commercial Solvents Company reports a consumption in the calendar year of 1928 of about 8,000,000 bu.

In commercial practice 1 bu. of corn yields about 2.4 wine gal. of alcohol, and 2.7 gal. of blackstrap molasses yields about 1 wine gal. of alcohol. In other words, 1 bushel of corn is equivalent to nearly 6½ gal. of blackstrap molasses.

The conversion cost of alcohol made from corn is about 3 to 5c. more per gallon than from molasses. An approximate total conversion cost for molasses to alcohol is 10c. per gallon of alcohol and for corn 15c. per gallon of alcohol. In the case of corn, the byproducts constitute an important credit.

One speaker characterized denatured alcohol as one of the largest factors in our manufacturing industries. He stated that animal consumption included 40,000,000 wine gal. in the anti-freeze trade, 25,000,000 wine gal. in cellulose nitrate, 8,000,000 wine gal. in varnish and lacquers, 5,000,000 wine gal. in toilet preparations, and 10,000,000 to 15,000,000 wine gal. in miscellaneous uses.

IN CONNECTION with the discussion on conversion costs a table prepared by Dr. W. N. Watson of the Tariff Commission was introduced. The table follows:

	Corn (94c. per bu.)	Corn (83½c. per bu.)	Molasses (9.5c. per gal.)	Molasses (6.5c. per gal.)
Raw materials:				
Corn.....	\$0.3670	\$0.3280		
Molasses.....			\$0.2565	\$0.1755
Barley and chemicals	.0501	.0501	.0050	.0050
Total raw materials	.4171	.3781	.2615	.1805
Conversion cost ¹.....	.1054	.1054	.0700	.0700
	.5225	.4835	.3315	.2505
Credit by-products....	.1155	.1155		
Net cost per wine gallon	.4070	.3680	.3315	.2505

¹ Includes total factory expense, insurance, depreciation, and overhead, but does not include selling expense, cost of denaturation, which amounts to about 2½c. a gallon for completely denatured formula.

Explanation of this table brought forth the statement that production costs for large plants, either corn or molasses—alcohol plants—running at or near capacity is less than the above figures. The table shows the cost of producing alcohol from corn and from molasses for large plants at or near capacity operation. These costs would be considerably increased when the operation is at 50 per cent capacity, and furthermore the costs for small plants would be more

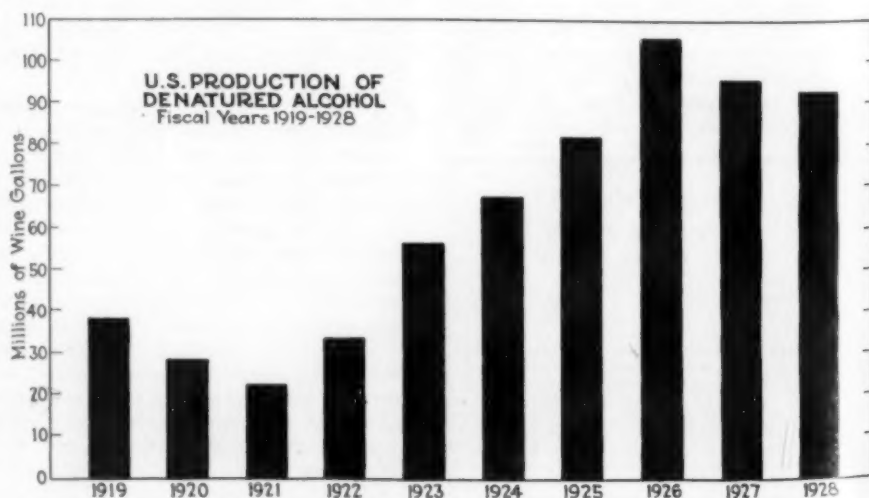
than the costs shown in the table. In the manufacture of alcohol from corn the byproducts are of high value and include distillers' grains, a valuable cattle food, which has sold in recent years for \$35 to \$45 per ton, or on an average of about 2c. per pound each bushel of corn gives about 12½ lb. of distillers' grains. In addition, fusel oil is another byproduct of small importance, and in certain cases corn oil and corn oil meal. The credit for byproducts amounts to about one-fifth of the gross cost and for capacity operation may exceed the conversion cost.

THE importance of synthetic ethyl alcohol as a future competitor of the distillation product was referred to on different occasions and a statement prepared by Dr. James M. Doran, Chief of the Prohibition Bureau, was presented. The statement reads as follows: "The

Production of Denatured Alcohol

	Completely Wine Gal.	Specialty Wine Gal.	Total Wine Gal.
1919.....	9,976,720	28,294,219	38,270,939
1920.....	13,528,403	15,307,947	28,836,350
1921.....	12,392,595	9,996,230	22,388,825
1922.....	16,193,523	17,152,224	33,345,747
1923.....	27,128,229	30,436,913	57,565,142
1924.....	34,602,003	33,085,292	67,687,295
1925.....	46,983,970	34,824,303	81,808,273
1926.....	65,881,442	39,494,444	105,375,886
1927.....	56,093,748	39,354,928	95,448,676
1928.....	46,966,601	45,451,424	92,418,025

Carbon & Carbide Chemicals Corporation, which is a subsidiary of the Union Carbide Company of New York, has operated an experimental plant on the synthetic production of ethyl alcohol from ethylene gas at South Charleston, W. Va. They are preparing to enlarge the operation greatly. There is no question about the technical success of the process. This same process was employed in Switzerland during the World War and is based on sound chemical principles. The supply of ethylene gas in only limited by the supply of petroleum, natural gas, and soft coal. The last 10 years has seen a great development in synthetic production of the alcohols and even gasoline by new developments of high-pressure apparatus and bringing about reaction by means of catalysts. None of these processes employ grain or other carbohydrates, and future production will undoubtedly run to the synthetic processes."



MARKET APPRAISAL OF CHEMICAL INDUSTRY

Net profit of Colgate-Palmolive-Peet Co. for year ended Dec. 31, 1928, was \$6,127,173 after taxes.

Mathieson Alkali Works has declared an initial quarterly dividend of 50c. on the common stock payable at the option of the shareholders in cash or in stock on the basis of one share for each 100 shares held.

Stockholders of By-Products Coke Corporation have voted to increase authorized capitalization to 800,000 no-par shares, from 200,000, to provide for 300 per cent stock dividend to be paid stockholders of record June 15.

American Commercial Alcohol Corporation declared an initial quarterly dividend of 40c. and an extra dividend of 3 per cent in stock on the common stock. This places stock on \$1.60 regular annual dividend basis.

Cleveland Cliffs Iron Company declared a cash dividend of \$5 and stock dividend of 1½ shares of preferred stock on common. Dividends were declared preparatory to formation of new holding company, Cliffs Corporation, to hold in voting trust all Cleveland Cliffs Iron common.

Directors of Tide Water Associated Oil Company have decided to offer 1½ shares of the common stock in exchange for each share of Tide Water Oil Co. common.

Procter & Gamble Company has purchased the Duz Company, manufacturer of soap powder. The acquisition was a cash transaction. The properties of Duz company will be absorbed by Procter & Gamble, which will hereafter produce Duz.

United Chemicals, Inc., for quarter ended March 31, 1929, reports net profit of \$176,233 after charges and taxes.

Directors of Vick Chemical Company have proposed a two for one split-up of the capital stock, and an increase in authorized shares from 400,000 to 1,200,000.

American Cyanamid Company has declared quarterly dividends of 40c. each on the Class A and Class B common, placing issues on \$1.60 annual basis, against 30c. and 10c. extra quarterly previously, and the regular quarterly dividend of \$1.50 on the preferred.

Davison Chemical Company has issued 32,682 additional shares of common stock for the purpose of acquiring control of Central Chemical Company, Berkshire Chemical Company and Lancaster Bone Fertilizer Company, all manufacturers of fertilizer.

Spencer Kellogg & Sons, Inc., is offering stockholders of record June 24 rights to additional stock on the basis of one share at \$32 to every 10 shares held. Rights will expire July 15. Stock required for this offering is now held by the company as treasury stock.

Stock	Price Range Since Jan. 1		Price Range in May			
	High	Low	May 1	High	Low	May 31
Air Reduction.....	133	95½	121½	133	118½	127½
Ajax Rubber.....	11½	4½	7½	7½	4½	4½
Allied Chemical.....	305½	241	283½	302½	270	275½
Allied Chemicals, pf.....	125	120½	124	124½	121	122½
Am. Ag. Chemical.....	23½	10½	16½	16½	10½	10½
Am. Ag. Chemical, pf.....	73½	40½	55½	55½	40½	41½
American Cyanamid, B.....	80	39½	62½	62½	39½	39½
American Hide & Leather.....	10	6½	7	8½	6½	8½
American Metals.....	81½	50	60	61½	50	54½
Am. Solvents & Chemical.....	40½	26½	32	32½	29	29½
Anglo-Chile Nitrate.....	45½	33	38½	42½	37½	38½
Archer-Daniels-Midland.....	110½	29	37½	39½	29	31½
Assoc. Dyeing & Printing.....	27½	17½	20½	25½	17½	19½
Atlas Powder.....	115	90	96	99½	90	.....
Beacon Oil.....	28½	20	22½	26	22½	24
Beechnut Packing.....	101	73	86	86	73	.....
Bon Ami, A.....	89½	78½	84½	88½	81	83½
Bristol-Myers.....	109½	84½	.....	96	84½	88
California Petroleum.....	30	26½	.....	27	27	.....
Celanese.....	57½	38½	42½	44½	38½	38½
Celanese, pf.....	122	102½	.....	113½	102½	.....
Certainteed.....	28½	16½	22½	26½	22½	24½
Chickasha Cotton Oil.....	50	38½	42½	44	38½	38½
Colgate-Palmolive-Peet.....	80½	63	70½	71	63	66½
Commercial Solvents.....	370	225½	361	370	322½	328½
Corn Products.....	101½	82	98½	99	86½	88
Davison Chemical.....	69½	42½	58½	59½	42½	43½
Devco & Reynolds.....	64½	44½	54½	55½	44½	45½
Devco & Reynolds, pf.....	115½	112	115	115	115	115
Du Pont.....	198½	155½	180	180	156	158
Du Pont, 6 pc. db.....	119	115½	117½	117½	115½	.....
Eastman Kodak.....	194½	168	178	184½	168	.....
Firestone Tire.....	309	220½	288	298	270	.....
Fisk Rubber.....	20½	8½	11½	11½	8½	8½
Fleischmann Co.....	84½	65½	67½	78	66½	74½
Freeport Texas.....	54½	38	45½	47½	38½	40
Glidden Co.....	50½	36½	49½	49½	42	45½
Glidden Co., pf.....	106½	101½	105	105½	101½	.....
Gold Dust.....	82	53½	64½	68½	53½	54½
Goodrich Co.....	105½	73	83½	86½	73	73½
Houston Oil.....	109	70½	97½	100	70½	75
Industrial Rayon.....	135	74	.....	112	74	75½
Int. Ag. Chemical.....	17½	8½	13½	13½	8½	8½
Int. Ag. Chemical, pf.....	88½	68½	74½	74½	68½	68½
International Paper.....	35½	25	30	30½	25	26½
International Salt.....	90½	55½	.....	80	70	70
Kelly-Springfield.....	23½	11	17½	19½	13½	13½
Lee Rubber & Tire.....	25	10	19½	19½	10	13½
Lehn & Fink.....	68½	51	56½	56½	51	51
Libby-Owens.....	220½	164	186	191	164	164
Liquid Carbonic.....	113½	71½	87½	88	75	77½
Mathieson Alkali.....	218	42½	50½	55½	42½	45½
Monsanto Chemical.....	27	16½	19½	19½	16½	19½
Nat'l Dist. Products.....	55½	33	51	52	40½	42½
National Lead.....	173	132	145	152½	142	142
New Jersey Zinc.....	335	279½	.....	.....	.....	.....
Ohio Oil.....	74½	64½	71	71	67	70½
Owens Bottle.....	84	78	.....	84	78	78½
Phillips Petroleum.....	47	37½	42½	43½	38½	38½
Pittsburgh Plate Glass.....	76½	64	66½	71½	65	.....
Pratt & Lambert.....	85	63½	.....	73½	69	69
Pure Oil.....	30½	23½	28	30½	27½	27½
Sherwin-Williams.....	105½	81	.....	105½	90	.....
Silica Gel.....	48½	23½	39½	42½	37½	37½
Sinclair Oil.....	45	35½	39½	40½	37½	38½
Skelly Oil.....	46½	32½	44½	46½	38½	39½
Standard Oil, Cal.....	81½	64	78½	81½	72½	73½
Standard Oil, N. J.....	62½	48	59½	62½	56	57
Standard Oil, N. Y.....	45½	38	42½	43½	38½	39½
Standard Plate Glass.....	9½	4½	5½	7½	5	5
Sun Oil.....	65	57	.....	65	60	60
Swan & Finch.....	18	14	.....	15	14	.....
Tennessee Copper & Chemical.....	20½	16	19½	20½	16½	17
Texas Corp.....	68½	57½	66	67½	61	62
Texas Gulf Sulphur.....	85½	70½	83½	84	70½	71½
Tidewater Oil.....	38	27½	35	38	33½	.....
Tubize Silk.....	550	335	.....	.....	.....	.....
Union Carbide.....	264½	196½	251	264½	245	.....
Union Oil, Cal.....	54½	46	51	51½	47½	47½
United Piece Dye.....	173½	128	172½	173½	152½	157½
U. S. Ind. Alcohol.....	35½	19½	23½	23½	19½	21½
U. S. Leather.....	65	42	57½	59½	45½	47½
U. S. Rubber.....	133½	.....	.....	.....	.....	.....
Vacuum Oil.....	116½	68	97½	98½	.....	70½
Vanadium Corp.....	109	82	91½	109	91½	99½
Vick Chemical.....	24½	10½	.....	17	9½	10½
Va. Ca. Chemical.....	97½	86½	90	91	86½	87½
Va. Ca. Chemical, pf.....	.....	.....	.....	.....	.....	.....
Wesson Oil.....	48	37	43	43	37½	38
Wilson & Co.....	13½	7	9½	9½	7	.....

CURRENT PRICES

in the NEW YORK MARKET

For Chemicals, Oils and Allied Products

The following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to June 17.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums.....lb.	\$0.14-\$0.15	\$0.14-\$0.15	\$0.13-\$0.14
Acid, acetic, 28%, bbl.....cwt.	3.88-4.03	3.88-4.03	3.38-3.63
Boric, bbl.....lb.	.06-.07	.06-.07	.06-.07
Citric, keg.....lb.	.46-.47	.46-.47	.46-.47
Formic, bbl.....lb.	.11-.12	.11-.12	.11-.12
Gallie, tech., bbl.....lb.	.50-.55	.50-.55	.50-.55
Hydrofluoric 30% carb.....lb.	.06-.07	.06-.07	.06-.07
Lactic, 44%, tech., light, bbl.....lb.	.11-.12	.11-.12	.13-.13
22%, tech., light, bbl.....lb.	.05-.06	.05-.06	.06-.07
Muriatic, 18%, tanks.....cwt.	.85-.90	.85-.90	.85-.90
Nitric, 36%, carboys.....lb.	.05-.05	.05-.05	.05-.05
Oleum, tanks, wks.....ton	18.00-20.00	18.00-20.00	18.00-20.00
Oxalic, crystals, bbl.....lb.	.11-.11	.11-.11	.11-.11
Phosphoric, tech., c'bya.....lb.	.08-.09	.08-.09	.08-.09
Sulphuric, 60% tanks.....ton	11.00-11.50	11.00-11.50	11.00-11.50
Tannic, tech., bbl.....lb.	.35-.40	.35-.40	.35-.40
Tartaric, powd., bbl.....lb.	.38-.39	.38-.39	.38-.39
Tungstic, bbl.....lb.	1.00-1.20	1.00-1.20	1.00-1.20
Alcohol, ethyl, 190 p'f., bbl.....gal.	2.68-2.71	2.68-2.71	2.68-2.71
Alcohol, Butyl, dr.....lb.	.16-.17	.17-.18	.18-.19
Denatured, 190 proof			
No. 1 special dr.....gal.	.50-.....	1.49-.....	1.45-.....
No. 3, 188 proof, dr.....gal.	.50-.....	1.49-.....	1.44-.....
Alum, ammonia, lump, bbl.....lb.	.03-.04	.03-.04	.03-.04
Chromic, bbl.....lb.	.05-.05	.05-.05	.05-.06
Potash, lump, bbl.....lb.	.03-.03	.03-.03	.02-.03
Aluminum sulphate, com., bags.....cwt.	1.40-1.45	1.40-1.45	1.40-1.45
Iron free, bg.....cwt.	2.00-2.10	2.00-2.10	2.00-2.10
Aqua ammonia, 26%, drums.....lb.	.03-.04	.03-.04	.03-.04
Ammonia, anhydrous, cyl.....lb.	.14-.....	.14-.....	.13-.....
Ammonium carbonate, powd., tech., casks.....lb.	.12-.13	.12-.13	.10-.14
Sulphate, wks.....cwt.	2.25-.....	2.35-.....	2.40-.....
Amylacetate tech., drums.....gal.	1.75-2.00	1.75-2.00	1.75-2.00
Antimony Oxide, bbl.....lb.	.11-.12	.10-.10	.13-.15
Arsenic, white, powd., bbl.....lb.	.04-.04	.04-.04	.04-.04
Red, powd., keg.....lb.	.09-.10	.09-.10	.09-.10
Barium carbonate, bbl.....ton	58.00-60.00	58.00-60.00	57.50-60.00
Chloride, bbl.....ton	65.00-67.00	65.00-67.00	55.00-58.00
Nitrate, cask.....lb.	.08-.09	.07-.08	.08-.08
Blanc fixe, dry, bbl.....lb.	.03-.04	.03-.04	.04-.04
Bleaching powder, f.o.b., wks, drums.....cwt.	2.00-2.10	2.00-2.10	2.00-2.10
Borax, bbl.....lb.	.02-.03	.02-.03	.04-.04
Bromine, ca.....lb.	.45-.47	.45-.47	.45-.47
Calcium acetate, bags.....cwt.	4.50-.....	4.50-.....	3.50-.....
Arsenate, dr.....lb.	.06-.07	.06-.07	.06-.07
Carbide, drums.....lb.	.05-.06	.05-.06	.05-.06
Chloride, fused, dr., wks.....ton	20.00-.....	20.00-.....	20.00-.....
Phosphate, bbl.....lb.	.08-.08	.08-.08	.07-.07
Carbon bisulphide, drums.....lb.	.05-.06	.05-.06	.05-.06
Tetrachloride drums.....lb.	.06-.07	.06-.07	.06-.07
Chlorine, liquid, tanks, wks.....lb.	.03-.03	.03-.03	.03-.04
Cylinders.....lb.	.05-.08	.05-.08	.05-.08
Cobalt oxide, cars.....lb.	2.10-2.20	2.10-2.20	2.10-2.25
Copperas, bags, f.o.b. wks.....ton	15.00-16.00	15.00-16.00	16.00-17.00
Copper carbonate, bbl.....lb.	.19-.21	.19-.21	.18-.19
Cyanide, tech., bbl.....lb.	.49-.50	.49-.50	.49-.50
Sulphate, bbl.....cwt.	6.00-6.10	6.00-6.10	5.30-5.50
Cream of tartar, bbl.....lb.	.27-.28	.27-.28	.25-.27
Diethylene glycol, dr.....lb.	.10-.15	.10-.15	.10-.15
Epsom salt, dom., tech., bbl.....cwt.	1.75-2.15	1.75-2.00	1.75-2.00
Imp., tech., bags.....cwt.	1.15-1.25	1.15-1.25	1.15-1.25
Ethyl acetate, drums.....gal.	1.03-.....	1.03-.....	.83-.....
Formaldehyde, 40%, bbl.....lb.	.09-.10	.09-.10	.08-.09
Furfural, dr.....lb.	.15-.17	.15-.17	.15-.17
Fusel oil, crude, drums.....gal.	1.30-1.40	1.30-1.40	1.30-1.40
Refined, dr.....gal.	1.90-2.00	1.90-2.00	2.50-3.00
Glaucous salt, bags.....cwt.	1.10-1.20	1.10-1.20	1.00-1.10
Glycerine, e.p., drums, extra.....lb.	.14-.14	.14-.15	.15-.16
Lead:			
White, basic carbonate, dry, casks.....lb.	.09-.....	.09-.....	.08-.....
White, basic sulphate, sek.....lb.	.08-.....	.08-.....	.07-.....
Red, dry, sek.....lb.	.10-.....	.10-.....	.09-.....
Lead acetate, white crys., bbl.....lb.	.14-.14	.14-.14	.13-.13
Lead arsenate, powd., bbl.....lb.	.13-.14	.13-.14	.12-.13
Lime, chem., bulk.....ton	8.50-.....	8.50-.....	8.50-.....
Litharge, powd., cask.....lb.	.09-.....	.09-.....	.08-.....
Lithopone, bags.....lb.	.05-.06	.05-.06	.05-.06
Magnesium carb., tech., bags.....lb.	.06-.06	.06-.06	.07-.08
Methanol, 95%, dr.....gal.	.55-.....	.55-.....	.43-.....
97%, dr.....gal.	.55-.....	.55-.....	.45-.....
Nickel salt, double, bbl.....lb.	.13-.13	.13-.13	.10-.10
Single, bbl.....lb.	.13-.13	.13-.13	.10-.11

	Current Price	Last Month	Last Year
Orange mineral, csk.....lb.	\$0.12-.....	\$0.12-.....	\$0.11-.....
Phosphorus, red, casks.....lb.	.55-.57	.55-.57	.62-.65
Yellow, casks.....lb.	.32-.33	.32-.34	.32-.33
Potassium bichromate, casks.....lb.	.08-.08	.08-.08	.08-.08
Carbonate, 80-85%, calc., csk.....lb.	.05-.06	.05-.06	.05-.06
Chlorate, powd.....lb.	.07-.08	.07-.08	.08-.09
Cyanide, ca.....lb.	.52-.55	.52-.55	.55-.57
First sort, csk.....lb.	.08-.09	.08-.09	.08-.09
Hydroxide (castio potash) dr.....lb.	.07-.07	.07-.07	.07-.07
Muriate, 80% bgs.....ton	36.75-.....	36.75-.....	36.40-.....
Nitrate, bbl.....lb.	.06-.06	.06-.06	.06-.07
Permanganate, drums.....lb.	.16-.16	.16-.16	.15-.16
Prussiate, yellow, casks.....lb.	.19-.19	.19-.19	.18-.19
Sal ammoniac, white, casks.....lb.	.04-.05	.04-.05	.04-.05
Sal soda, bbl.....cwt.	.90-.95	.90-.95	.90-.95
Salt cake, bulk.....ton	16.00-18.00	16.00-18.00	17.00-19.00
Soda ash, light, 58%, bags, contract.....cwt.	1.32-.....	1.32-.....	1.32-.....
Dense, bags.....cwt.	1.35-.....	1.35-.....	1.35-.....
Soda, caustic, 76%, solid, drums, contract.....cwt.	2.90-3.00	2.90-3.00	3.00-3.10
Acetate, works, bbl.....lb.	.06-.06	.05-.05	.05-.06
Bicarbonate, bbl.....cwt.	2.00-2.25	2.00-2.25	2.00-2.25
Bichromate, casks.....ton	.07-.07	.07-.07	.07-.07
Bisulphate, bulk.....ton	12.00-15.00	12.00-15.00	3.00-3.50
Bisulphite, bbl.....lb.	.03-.03	.03-.03	.03-.04
Chlorate, keg.....lb.	.07-.07	.07-.07	.06-.06
Chloride, tech.....ton	12.00-14.75	12.00-14.75	12.00-14.00
Cyanide, casks, dom.....lb.	.18-.22	.18-.22	.18-.22
Fluoride, bbl.....lb.	.08-.09	.08-.09	.08-.09
Hyposulphite, bbl.....lb.	2.50-3.00	2.50-3.00	2.50-3.00
Nitrate, bags.....cwt.	2.15-.....	2.15-.....	2.22-.....
Nitrite, casks.....lb.	.07-.08	.07-.08	.07-.08
Phosphate, dibasic, bbl.....lb.	.03-.03	.03-.03	.03-.03
Prussiate, yel. drums.....lb.	.11-.12	.11-.12	.11-.12
Silicate (30% drums).....cwt.	.75-1.15	.75-1.15	.75-1.15
Sulphide, fused, 60-62% dr.....lb.	.02-.03	.02-.03	.03-.04
Sulphite, crys., bbl.....lb.	.02-.03	.02-.03	.02-.03
Strontium nitrate, bbl.....lb.	.09-.09	.09-.09	.09-.09
Sulphur, crude at mine, bulk.....ton	18.00-.....	18.00-.....	18.00-.....
Chloride, dr.....lb.	.04-.05	.04-.05	.04-.05
Dioxide, cyl.....lb.	.09-.10	.09-.10	.09-.10
Flour, bag.....cwt.	1.55-3.00	1.55-3.00	1.55-3.00
Tin bichloride, bbl.....lb.	.14-.....	.14-.....	.15-.....
Oxide, bbl.....lb.	.53-.....	.53-.....	.56-.....
Crystals, bbl.....lb.	.35-.....	.35-.....	.37-.....
Zinc chloride, gran., bbl.....lb.	.06-.06	.06-.06	.06-.06
Carbonate, bbl.....lb.	.10-.11	.10-.10	.10-.11
Cyanide, dr.....lb.	.40-.41	.40-.41	.40-.41
Dust, bbl.....lb.	.08-.09	.08-.09	.09-.10
Zinc oxide, lead free, bag.....lb.	.06-.....	.06-.....	.06-.....
5% lead sulphate, bags.....lb.	.06-.....	.06-.....	.06-.....
Sulphate, bbl.....cwt.	3.50-3.75	2.75-3.00	2.75-3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl.....lb.	\$0.13-0.14	\$0.13-0.14	\$0.13-0.14
Chinawood oil, bbl.....lb.	.14-.....	.15-.....	.14-.....
Cocoon oil, Ceylon, tanks, N. Y.....lb.	.06-.....	.07-.....	.08-.....
Corn oil, crude, tanks, (f.o.b. mill).....lb.	.08-.....	.08-.....	.08-.....
Cottonseed oil, crude (f.o.b. mill), tanks.....lb.	.08-.....	.08-.....	.08-.....
Linseed oil, raw, ear lots, bbl.....lb.	.104-.....	.101-.....	.102-.....
Palm, Lagos, casks.....lb.	.07-.....	.08-.....	.07-.....
Niger, casks.....lb.	.07-.....	.08-.....	.09-.....
Palm Kernel, bbl.....lb.	.08-.....	.08-.....	.09-.....
Peanut oil, crude, tanks (mill).....lb.	.83-84	.82-83	.90-92
Rapeseed oil, refined, bbl.....gal.	.08-.....	.09-.....	.09-.....
Soya bean tank (f.o.b. Coast).....lb.	.09-.....	.10-.....	.09-.....
Sulphur (olive foot), bbl.....lb.	.65-.67	.65-.67	.66-.67
Cod, Newfoundland, bbl.....gal.	.70-72	.70-72	.60-66
Menhaden, light pressed, bbl.....gal.	.42-.....	.45-.....	.45-.....
Crude, tanks (f.o.b. factory).....gal.	.40-.....	.40-.....	.40-.....
Whale, crude, tanks.....gal.	.06-.....	.07-.....	.06-.....
Grease, yellow, loose.....lb.	.09-.....	.09-.....	.09-.....
Oleo stearine.....lb.	.09-.....	.09-.....	.09-.....
lled oil, distilled, d.p. bbl.....lb.	.07-10	.07-10	.09-09
Tallow, extra, loose.....lb.	.07-.....	.07-.....	.08-.....

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl.....lb.	\$0.60-0.65	\$0.60-0.65	\$0.60-0.62
Refined, bbl.....lb.	.80-.85	.80-.85	.85-.90
Alpha-naphthylamine, bbl.....lb.	.32-.34	.32-.34	.35-.36
Aniline oil, drums, extra.....lb.	.14-.15	.14-.15	.15-.16
Aniline salts, bbl.....lb.	.24-.25	.24-.25	.24-.25
Anthracene, 80%, drums.....lb.	.60-.65	.60-.65	.60-.65

Coal Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr.... lb.	1.15 - 1.25	1.15 - 1.35	1.15 - 1.25
Benzidine base, bbl.... lb.	.67 - .70	.67 - .70	.70 - .72
Benzic acid, U.S.P., kgs.... lb.	.57 - .60	.57 - .60	.58 - .60
Benzyl chloride, tech, dr.... lb.	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works... gal.	.23 - .25	.23 - .25	.21 - .22
Beta-naphthol, tech., drums lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr.... lb.	.14 - .17	.14 - .17	.18 - .20
Cresylic acid, 97%, dr., wks. gal.	.70 - .73	.73 - .75	.73 - .75
Diethylaniline, dr.... lb.	.55 - .58	.55 - .58	.58 - .60
Dinitrophenol, bbl.... lb.	.30 - .32	.30 - .31	.31 - .35
Dinitrotoluen, bbl.... lb.	.17 - .18	.17 - .18	.17 - .18
Dip oil, 25% dr.... gal.	.26 - .28	.26 - .28	.28 - .30
Diphenylamine, bbl.... lb.	.42 - .43	.42 - .43	.45 - .47
H-acid, bbl.... lb.	.60 - .63	.60 - .63	.63 - .65
Naphthalene, flake, bbl.... lb.	.044 - .05	.044 - .05	.05 - .06
Nitrobenzene, dr.... lb.	.09 - .10	.09 - .10	.09 - .10
Para-nitraniline, bbl.... lb.	.55 - .56	.55 - .56	.52 - .53
Para-nitrotoluene, bbl.... lb.	.29 - .31	.29 - .31	.28 - .32
Phenol, U.S.P., drums.... lb.	.13 - .14	.13 - .14	.17 - .18
Picric acid, bbl.... lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr.... lb.	1.75 - 1.90	1.75 - 1.90	1.90 - 1.95
R-salt, bbl.... lb.	.44 - .45	.44 - .45	.47 - .50
Resorcinol, tech, kgs.... lb.	1.30 - 1.35	1.30 - 1.35	1.30 - 1.40
Salicylic acid, tech., bbl.... lb.	.30 - .32	.30 - .32	.30 - .32
Solvent naphtha, w.w., tanks gal.	.30 - .35	.30 - .35	.35 - .38
Tolidine, bbl.... lb.	.86 - .90	.86 - .90	.95 - .96
Toluene, tanks, works.... gal.	.45 - .48	.45 - .48	.35 - .38
Xylene, com., tanks.... gal.	.30 - .40	.30 - .35	.36 - .40

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl.... ton	\$23.00-\$25.00	\$23.00-\$25.00	\$23.00-\$25.00
Casain, tech., bbl.... lb.	.154 - .16	.16 - .164	.16 - .18
China clay, dom., f.o.b. mine ton	10.00 - 20.00	10.00 - 20.00	10.00 - 20.00
Dry colors:			
Carbon gas, black (wks.).... lb.	.08 - .13	.08 - .13	.064 - .07
Prussian blue, bbl.... lb.	.35 - .36	.32 - .33	.31 - .32
Ultramarine blue, bbl.... lb.	.06 - .32	.08 - .35	.08 - .35
Chrome green, bbl.... lb.	.30 - .32	.30 - .32	.27 - .30
Carmin red, tins.... lb.	6.00 - 6.50	6.00 - 6.50	5.50 - 5.75
Para toner.... lb.	.70 - .75	.70 - .75	.70 - .80
Vermilion, English, bbl.... lb.	1.85 - 2.00	1.90 - 2.00	1.80 - 1.85
Chrome yellow, C. P., bbl lb.	.17 - .174	.16 - .164	.17 - .18
Feldspar, No. 1 (f.o.b. N. C.) ton	6.50 - 7.50	5.75 - 7.00	5.75 - 7.00
Graphite, Ceylon, lump, bbl lb.	.074 - .084	.08 - .084	.08 - .09
Gum copal, Congo, bags.... lb.	.074 - .08	.074 - .08	.074 - .08
Manila, bags.... lb.	.16 - .17	.16 - .17	.15 - .18
Damar, Batavia, cases.... lb.	.24 - .25	.24 - .25	.25 - .25
Kauri, No. 1 cases.... lb.	.48 - .53	.48 - .53	.48 - .53
Kieselguhr (f.o.b. N. Y.).... ton	50.00 - 55.00	50.00 - 55.00	50.00 - 55.00
Magnesite, calc.... ton	40.00 - 40.00	40.00 - 40.00	44.00 - 44.00
Pumice stone, lump, bbl.... lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks.... lb.	.03 - .40	.03 - .40	.03 - .35
Rosin, H.... bbl.	8.45 - 8.45	8.45 - 8.45	9.00 - 9.00
Turpentine.... gal.	.52 - .54	.54 - .54	.534 - .534
Shellac, orange, fine, bags.... lb.	.61 - .61	.61 - .61	.51 - .52
Bleached, bonedry, bags.... lb.	.58 - .59	.56 - .58	.54 - .56
T. N. bags.... lb.	.43 - .44	.42 - .43	.44 - .45
Soapstone (f.o.b. Vt.), bags.... ton	10.00 - 12.00	10.00 - 12.00	10.00 - 12.00
Talc, 200 mesh (f.o.b. Vt.).... ton	9.50 - 9.50	9.50 - 9.50	10.50 - 10.50
300 mesh (f.o.b. Ga.).... ton	7.50 - 10.00	7.50 - 10.00	7.50 - 11.00
225 mesh (f.o.b. N. Y.).... ton	13.75 - 13.75	13.75 - 13.75	13.75 - 13.75

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl.... lb.	\$0.28 - \$0.32	\$0.28 - \$0.31	\$0.24 - \$0.26
Beeswax, ref., light.... lb.	.41 - .42	.41 - .42	.43 - .45
Candelilla, bags.... lb.	.23 - .24	.22 - .24	.24 - .27
Carnauba, No. 1, bags.... lb.	.36 - .38	.36 - .38	.54 - .55
Paraffine, crude 105-110 m.p.... lb.	.044 - .05	.044 - .05	.044 - .05

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%.... ton	\$200.00 - 200.00	\$200.00 - 200.00	\$200.00 - 200.00
Ferromanganese, 70-82%.... ton	105.00 - 105.00	105.00 - 105.00	100.00 - 100.00
Spiegelisen, 19-21%.... ton	33.00 - 33.00	33.00 - 33.00	31.00 - 32.00
Ferrosilicon, 14-17%.... ton	45.00 - 45.00	45.00 - 45.00	33.00 - 36.00
Ferrotungsten, 70-80%.... lb.	1.35 - 1.35	1.25 - 1.25	90 - 95
Ferro-uranium, 35-50%.... lb.	4.50 - 4.50	4.50 - 4.50	4.50 - 4.50
Ferrovanadium, 30-40%.... lb.	3.15 - 3.75	3.15 - 3.75	3.15 - 3.75

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic.... lb.	\$0.18 - .26	\$0.18 - .26	\$0.14 - .25
Aluminum, 96-99%.... lb.	.24 - .26	.24 - .26	.24 - .25
Antimony, Chin. and Jap.... lb.	.084 - .094	.094 - .094	.104 - .104
Nickel, 99%.... lb.	.35 - .35	.35 - .35	.35 - .35
Monel metal, blocks.... lb.	.28 - .28	.28 - .28	.28 - .28
Tin, 5-ton lots, Straits.... lb.	.434 - .444	.444 - .444	.484 - .484
Lead, New York, spot.... lb.	7.00 - 7.00	7.00 - 7.00	6.30 - 6.30
Zinc, New York, spot.... lb.	7.00 - 7.00	6.90 - 6.90	6.50 - 6.50
Silver, commercial.... oz.	524 - 544	544 - 544	574 - 574
Cadmium.... lb.	.85 - .95	.85 - .95	.60 - .60
Bismuth, ton lots.... lb.	1.70 - 1.70	1.70 - 1.70	1.85 - 2.10
Cobalt.... lb.	2.10 - 2.50	2.10 - 2.50	2.50 - 2.50
Magnesium, ingots, 99%.... lb.	.85 - 1.10	.85 - 1.10	.98 - .98
Platinum, ref.... oz.	66.00 - 68.00	70.00 - 72.50	85.00 - 85.00
Palladium, ref.... oz.	38.00 - 40.00	38.00 - 40.00	46.00 - 49.00
Mercury, flask.... 75 lb.	123.00 - 123.00	123.00 - 123.00	123.00 - 123.00
Tungsten powder.... lb.	1.35 - 1.50	1.20 - 1.35	1.05 - 1.05

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks.... ton	\$7.50 - \$8.00	\$7.50 - \$8.50	\$5.50 - \$8.75
Chrome ore, c.f. post.... ton	22.00 - 25.00	22.00 - 24.00	22.00 - 23.00
Coke, f.dry., f.o.b. oven.... ton	2.85 - 3.00	2.85 - 3.00	2.85 - 3.00
Fluorspar, gravel, f.o.b. Ill.... ton	18.00 - 20.00	18.00 - 20.00	14.50 - 14.50
Ilmenite, 52% TiO ₂ , Va.... lb.	.004 - .004	.004 - .004	.004 - .004
Manganese ore, 50% Mn., c.f. Atlantic Ports.... unit	.34 - .37	.34 - .37	.36 - .38
Molybdenite, 85% MoS ₂ per lb. MoS ₂ , N. Y.... lb.	.48 - .50	.48 - .50	.48 - .50
Monazite, 6% of ThO ₂ ton	80.00 - 80.00	130.00 - 130.00	120.00 - 120.00
Pyrites, Span. fines, c.f.... unit	.13 - .13	.13 - .13	.134 - .134
Rutile, 94-96% TiO ₂ lb.	.11 - .13	.11 - .13	.11 - .13
Tungsten, scheelite, 60% WO ₃ and over.... unit	15.00 - 15.00	15.00 - 15.00	11.25 - 11.50
Vanadium ore, per lb. V ₂ O ₅ lb.	.28 - .28	.28 - .28	.25 - .28
Zircon, 99%.... lb.	.03 - .03	.03 - .03	.03 - .03

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

Asphalt Plant—Asphalt Corp. of New Jersey, H. Ferber, Pres., 65 Court St., Hackensack, N. J., awarded contract for a 2 story asphalt manufacturing plant on Court St. to F. D. Cummer & Son Co., 2229 Woodmere Dr., Cleveland, O. Estimated cost \$100,000.

Asphalt Roofing Factory—American Asphalt Roofing Corp., 16th St. and Blue River, Kansas City, Mo., is having preliminary sketches made for the construction of a 1 story, 103 x 135 ft. addition to factory. C. A. Smith, 800 Finance Bldg., Kansas City, is architect.

Brass Accessory Factory—Clayton Lambert Co., French Rd., Detroit, Mich., awarded contract for the construction of a 1 story, 100 x 100 ft. factory for the manufacture of torches and automobile accessories to J. A. Utley, 700 Harper Ave., Detroit. Estimated cost \$40,000.

Brass Manufacturing Equipment—Canadian Ohio Brass Co., Niagara Falls, Ont., is the market for equipment for the manufacture of brass.

Brick Plant—M. M. Bushong, Clinton, Okla., will build a brick plant. Estimated cost \$150,000. Private plans. Work will be done by day labor.

Brick and Clay Plant—Choctaw Clay Corp., R. J. Wilkinson, Pres., New Orleans, La., plans the construction of a plant for the production of oxidized clay and Fullers earth for the market also insulated brick at Needham, Ala. Estimated cost \$500,000.

Carbide Gas Plant—Union Carbide & Carbon Co., 30 East 42nd St., New York, N. Y., awarded contract for the construction of a 1 story, 50 x 60 and 44 x 131 ft. plant on Kirtland St., Grand Rapids, Mich., to John McNabb & Sons, 204 Murray Bldg., Grand Rapids. Estimated cost \$52,000.

Carbon Black Plant—Western Carbon Co., subsidiary of Columbian Carbon Co., 45 East 42nd St., New York, N. Y., plans additional unit to carbon black plant at Borger, Tex., also two additional units to plant at LeFors. \$150,000.

Cement Plant—International Cement Corp., 342 Madison Ave., New York, N. Y., awarded contract for the construction of a cement plant including packing plant, 8 silos each 80 ft. high, elevating and conveying equipment, etc. at 34th and K Sts., Washington, D. C. to Rust Engineering Co., 606 Grant St., Pittsburgh, Pa. Estimated cost \$300,000 to \$400,000.

Chemical Plant—McGean Chemical Co., 1822 B. F. Keith Bldg., Cleveland, O., awarded contract for the construction of a group of buildings for chemical plant at 2910 Harvard Ave. to Craig-Curtiss Co., 4614 Prospect Ave., Cleveland. Estimated cost \$250,000.

Chemical Factory—Newport Chemical Works, Inc., Gregory Ave., Passaic, N. J., will build a 3 story, 50 x 75 ft. addition to factory on River Drive. Estimated cost \$40,000. Private plans. Work will be done by separate contracts.

Chemical Factory—Victory Chemical Co., 148 Fairmount Ave., Philadelphia, Pa., awarded contract for the construction of a 3 story chemical factory at Roberts Ave. and Pulaski St. to W. Steele & Sons Co., 15th and Cherry Sts., Philadelphia.

Chemical Factory—Charles Lennig & Co., Inc., Richmond and Kennedy Sts., Philadelphia, Pa., plans the construction of a 1 story, 50 x 80 ft. chemical factory, to Chemical Construction Co., 1206 South Blvd., Charlotte, N. C.

Chemical Plant Addition—Stanley Chemical Co., East Berlin, Conn., awarded contract for a 1 story, 45 x 75 ft. addition to chemical plant. Estimated cost \$20,000.

China Factory—Jackson Vitrified China Co., Falls Creek, Pa., plans the construction of a 1 and 2 story plant, 48 x 80, 26 x 80 and 48 x 90 ft. Estimated cost \$75,000. W. H. Overdorff, 23 Long Ave., Dubois, Pa., is architect.

Cleaning Products Factory—Cummer Products Co., M. Amster, Pres., 2150 West 15th St., Cleveland, O., plans the construction of a 1 story, 90 x 360 ft. factory for manufacture of shaving cream and liquid cleaner, on Dunham Rd., Maple Heights (br. Cleveland). Estimated cost \$150,000. Private plans.

Cold Settling Plant—Gulf Refining Co., Frick Annex, Pittsburgh, Pa., is having plans prepared for the construction of a cold settling plant at Girard Point, Philadelphia. Estimated cost \$150,000. E. B. Lee, Chamber of Commerce Bldg., Pittsburgh, is architect.

Compressed Gas Plant—Linde Air Products Co., Shreveport, La., awarded contract for a 1 story addition to plant on Agurs St. to J. M. Brown, Shreveport. Estimated cost \$46,000.

Copper Refinery—International Nickel Co., Coppercliff, Ont., awarded contract for the construction of a copper refinery to Fraser, Brace Ltd., Craig St., Montreal, Que. Estimated cost \$4,000,000.

Cotton Compress Plant—Paris Compress Co., Paris, Tex., plans the construction of a cotton compress plant. Estimated cost \$40,000. Private plans. Machinery and equipment will be required.

Distillery—Carling Breweries Ltd., C. Burns, Mgr., Talbot St., London, Ont., plans to completely remodel present building, also 3 story, 150 x 200 ft. addition to plant and new boiler house on Whitehall St., Chatham. Estimated cost \$250,000. Work will be done by day labor. Complete equipment will be required.

Enameling Plant—Empire Stove & Furnace Co., Third Ave. E., Owen Sound, Ont., plans a 50 x 90 ft. enameling plant. Estimated cost \$25,000.

Gas Booster Station—Magnolia Gas Co., Magnolia Bldg., Dallas, Tex., have acquired an 82 acre site near Beeville, and plans the construction of a gas booster station. Estimated cost \$100,000. Private plans.

Gas Manufacturing Plant—Connecticut Chemical Co., W. B. Lasher, Pres., 929 Connecticut Ave., Stratford, Conn., plans the construction of a gas manufacturing plant on Lordship St. Estimated cost \$40,000. Architect not selected.

Gas Plant—Atlantic Gas Co., C. M. Sturkey, Lewis Bldg., Philadelphia, Pa., plans the construction of a central gas plant to supply towns of Radford, Dublin and Pulaski, Va. Estimated cost \$750,000.

Gas Plant—City of St. Thomas, Ont., plans to completely overhaul and modernize municipal gas plant, also install new equipment.

Gasoline Plant—Atlantic Oil Production Co., Tulsa Trust Bldg., Tulsa, Okla., is having preliminary plans prepared for the construction of an absorption gasoline plant near Okewah. Estimated cost \$75,000.

Gasoline Plant—P. Zobisch, Butler, Okla., is having preliminary plans prepared for the construction of a casinghead gasoline plant. Estimated cost \$100,000. Private plans.

Glass Factory—Long Beach Glass Co., Long Beach, Calif., plans the construction of a factory to include two blast furnaces on Montana Ranch. Estimated cost \$500,000.

Glass Manufacturing Plant—Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, Pa., is having plans prepared for the construction of a 1 story plant at Santa Ana, Calif. Estimated cost \$4,000,000. Private plans.

Hydrogen Plant—Cudahy Packing Co., 803 Macy St., Los Angeles, Calif., will soon award contract for the construction of a packing plant to include 38 x 61 ft. hydrogen plant, hydro-generating building, etc. on Macy St. Private plans.

Ink Factory—International Inks, Inc., c/o P. Ruxton, Inc., 2211 Elston Ave., Chicago, Ill., is having plans prepared for the construction of a 4 story, 102 x 200 ft. printing ink factory. Estimated cost \$250,000. A. Epstein, 2001 Pershing Rd., Chicago, is architect.

Laboratory—Aluminum Co. of America, Oliver Bldg., Pittsburgh, Pa., will build a 1 and 3 story laboratory at New Kensington, Pa. Estimated cost \$250,000. P. Hogner, c/o owner, is architect.

Laboratory—Harvard College, Cambridge, Mass., plans the construction of a laboratory. Estimated cost \$500,000. Architect not selected.

Laboratory—Republic Ceresoting Co., 1614 Merchants Bank Bldg., Indianapolis, Ind., awarded contract for a 2 story, 50 x 80 ft. laboratory at Minnesota and Tibbs Aves. to Michael's Bros., 5829 Central Ave., Indianapolis. Estimated cost \$3,000.

Laboratory, Etc.—Westinghouse Lamp Co., Clearfield Ave., Bloomfield, N. J., awarded contract for the construction of a 5 story, 150 x 160 ft. laboratory, etc., on Arlington Ave. to Stone & Webster Engineering Corp., 120 Broadway, New York, N. Y. Estimated cost \$200,000.

Laboratory (Chemistry)—Bd. of Education, Sault Ste Marie, Ont., awarded contract for the construction of a 2 story, 75 x 100 ft. school, including chemistry laboratory, etc., on Main St., to R. F. Harten, 40 Waymas, Sault Ste Marie. Estimated cost \$125,000.

Laboratory (Electrical Engineering)—University of Illinois 256 Administration Bldg., Urbana, Ill., awarded contract for remodeling electrical engineering laboratory to A. W. Stoolman, Urbana. Estimated cost \$60,000.

Laboratory (Mechanical Engineering)—University of Texas, J. W. Calhoun, Comptroller, Austin, Tex., will soon award contract for the construction of a mechanical engineering laboratory. Estimated cost \$180,000. H. M. Greene, La Roche & Dahl Construction Industries Bldg., Dallas, are architects.

Laboratories, etc.—Sealy & Smith Foundation Co., Galveston, Tex., will soon award contract for the construction of a 4 story clinic including laboratories, etc. Estimated cost \$400,000. R. L. White, c/o University of Texas, Galveston, is architect. C. G. Parnell, 255 Culver Rd., Rochester, N. Y., is consulting architect.

Laboratories (Physics and Chemistry)—Bd. of Education, R. H. Foster, Secy., City Hall, Hamilton, Ont., will receive bids about June 18 for a 4 story, 165 x 395 ft. high school, to include physics and chemistry laboratories, etc., to cost \$1,250,000.

Match Factory—E. B. Eddy Co. Ltd., Hull, Que., plans the construction of a match factory at Red Deer, Alta. Estimated cost \$500,000.

Metakloth Factory—Liebau & Breiby, 238 Main St., Hackensack, N. J., Archts., will receive bids about June 23, for the construction of a 1 story addition to factory on Garibaldi Ave. for Metakloth Co. Inc., Garibaldi Ave., Lodi, N. J. Estimated cost \$40,000.

Mosaic Factory—American Mosaic & Terrazzo Co., 415 South Irving Ave., Chicago, Ill., is having plans prepared for the construction of a 2 story, 50 x 125 ft. factory on Carroll Ave. Estimated cost \$35,000. C. E. Frazier, 64 West Randolph St., Chicago, is architect. Machinery and equipment will be required.

Oil Cloth Plant Equipment—Columbus-Union Oil Cloth Co., H. E. Nesbitt, V. Pres., Seventh Ave., Columbus, O., is in the market for machinery and equipment for the manufacture of oil cloth for proposed addition to plant.

Oil Flotation Plant—Hinsdale Mining & Smelting Co., Durango, Colo., plans installing a 200 ton oil flotation plant.

Oil and Grease Equipment Factory—Merit Equipment Co., H. L. Wertz, Pres., 6616 Morgan Ave., Cleveland, O., awarded contract for a 1 story, 50 x 100 and 20 x 33 ft. factory for the manufacture of oil and grease, to Trucon Steel Co., 4600 Euclid Ave., Cleveland. Estimated cost \$40,000.

Paint Mills—Dean & Barry, 296 North Water St., R. S. McKay, Pres., Columbus, O., is in the market for three paint mills and other equipment for proposed 2 story, 48 x 75 ft. factory on North St. Estimated cost \$50,000. Private plans.

Paper Mache Factory—Old King Cole Inc., 920 Market Ave. S., Canton, O., awarded contract for the construction of a 2 story, 100 x 180 ft. factory for the manufacture of paper mache products to Warren-Hoffman Co., Whittiers Bldg., Canton. Estimated cost \$40,000.

Paper Mill—Abitibi Power & Paper Co. Ltd., Sault Ste. Marie, Ont., plans extensions and alterations to paper mill. Estimated cost \$1,000,000.

Paper Mill—Carpenter Paper Co., Salt Lake City, Utah, is having preliminary plans prepared for the construction of a warehouse in connection with paper mill at Pierpont and West Temple Sts. Estimated cost \$150,000.

Paper Plant—Chemical Paper Co., R. Bosworth, Holyoke, Mass., is receiving bids for a 2 story, 60 x 215 and 60 x 107 ft. paper plant on Jackson St. Estimated cost \$175,000. Private plans.

Paper Plant—Minnesota & Ontario Paper Co., 1100 Builders Exchange Bldg., Minneapolis, Minn., will build a 5 story, 140 x 165 ft. warehouse for paper plant at International Falls. Estimated cost \$35,000. Private plans. Work will be done by owners forces.

Paper Products Plant—Superior Paper Products Co., Carnegie, Pa., is having plans prepared for a 1 story, 180 x 280 ft. plant. Estimated cost \$200,000. Private plans.

Platinum Factory—American Platinum Works, 231 New Jersey Railroad Ave., Newark, N. J., awarded contract for a 2 story 40 x 125 ft. addition to factory at Oliver St. and New Jersey Railroad Ave. to E. M. Waldron Inc., 40 Park Pl., Newark. Estimated cost \$50,000.

Pottery—Trenton Potteries Co., North Clinton and Ott Sts., Trenton, N. J., awarded contract for the construction of a 5 story pottery plant to Karno-Smith Co., Broad St. Bank Bldg., Trenton. Estimated cost \$230,000.

Porcelain Factory—Champion Porcelain Co., 4525 Butler Ave., Hamtramck, Mich., awarded contract for the construction of a 1 story, 80 x 235 ft. factory to C. O. Barton Co., 1900 East Jefferson Ave., Detroit. Estimated cost \$50,000.

Powder Magazine Buildings—Bureau of Yards & Docks, Navy Dept., Washington, D. C., plans the construction of five powder magazine buildings at Naval Ammunition Dept., Boston, Mass.

Pulp and Paper Mill Addition—Rainier Pulp & Paper Co., Shelton, Wash., plans the construction of a 25 x 40 ft. digester building, in connection with pulp and paper mill.

Rayon Mill—Skenandos Rayon Corp., 1201 Broad St., Utica, N. Y., is having plans prepared for addition to rayon mill. Estimated cost \$3,500,000. W. E. Dyer, Land Title Bldg., Philadelphia, Pa., is engineer.

Refinery—Texas Empire Pipe Line Co., subsidiary Cities Service Co., 60 Wall St., New York, N. Y., will soon award contract for the construction of a refinery at Cline and Chicago Aves., East Chicago, Ind. Estimated cost \$5,000,000. C. Briggs, Bartlesville, Okla., in charge.

Refinery (Gas)—Western Oil & Refining Co., Wilmington, Calif., awarded contract for the construction of a gas refinery to include tank facilities, etc., 300,000 gal. daily capacity, to C. F. Braun Corp., Alhambra. Estimated cost \$3,000,000.

Refinery (Oil)—G. B. Eggleston & Co., Milan Bldg., San Antonio, Tex., (owners representatives) plan the construction of an oil refinery, 2,500 bbl. daily capacity, to include two stills, etc. at Corpus Christi, Tex. Estimated cost \$200,000.

Refinery (Oil) and Gas Plant—Rio Grande Oil Corp., El Paso, Tex., will build an oil lubricating and gas refinery. Estimated cost \$1,000,000. Private plans.

Refinery (Petroleum)—Standard Oil Co., 137 West 11th St., Indianapolis, Ind., is having plans prepared for the construction of a petroleum refining plant at 23rd, Ralston and Hillside Sts. Estimated cost \$100,000.

Refinery (Sugar)—American Beet Sugar Co., Steel Bldg., Denver, Colo., awarded contract for the construction of a 69 x 212 ft. sugar refinery at Belmont, Ia. to M. M. Moen & Co., Mason City, Ia.

Rubber Factory—Firestone Tire & Rubber Co., South Main St., Akron, O., awarded contract for first unit of new battery plant 2 story, 50 x 100 ft. for rubber factory to Carmichael Construction Co., Central Savings & Trust Bldg., Akron. Estimated cost \$200,000; also a 180' x 460' ft. addition to factory and 5 story warehouse addition at South Gate, Calif. to J. V. McNeil Co., 5860 Avalon Blvd., Los Angeles, Calif.

Rubber Factory—B. F. Goodrich Rubber Co., South Main St., Akron, O., awarded contract for a 3 story, 75 x 200 ft. factory to Clemmer & Noah, Second National Bldg., Akron. Estimated cost \$300,000.

Rubber Factory—Kaufman Rubber Co. Ltd., Kitchener, Ont., plans addition to factory on North Francis St. Estimated cost \$125,000.

Rubber Factory Addition—Eastern Rubber Co. Ltd., Actonville, Que., plans addition to factory. Estimated cost \$50,000.

Soap Factory—C. Jackson, Commercial Attache, Rio de Janeiro, Sao Paulo, Brazil, reports the purchase of a 250 x 300 ft. site for a factory for production of soap and compounds, 500 ton daily capacity, for an English firm.

Soap Factories—Procter & Gamble Co., Gwynne Bldg., Cincinnati, O., awarded contract for a factory to include 2 story, 60 x 80 ft. process buildings, 4 story, 60 x 80 ft. warehouse, alterations to glycerine house on Burlington St., Hamilton, Ont., to W. H. Cooper, Clyde Block, Hamilton, \$150,000; factory to include process, chipso, kettle and bar soap buildings, etc., at Baltimore, Md., to Frainie Bros. & Haigley, 19 West Franklin St., Baltimore, \$1,000,000; also plans a factory at Long Beach, Calif., \$500,000.

Smelting Plant—H. Kramer & Co., 2125 Loomis St., Chicago, Ill., awarded masonry contract for the construction of a smelting plant at 21st and Loomis Sts. to H. Anderson, 4127 North Central Park Ave.

Stove Plant Addition—Independence Stove & Furnace Co., 700 South Cottage St., Independence, Mo., awarded contract for a 1 story, 65 x 120 ft. addition for enameling department of stove and furnace works to L. W. Weeks, 633 South Fuller St., Independence. Estimated cost \$50,000.

Strawboard and Paperboard Mill—Hinde & Dauche Paper Co., 43 Hanna St., Toronto, Ont., plans the construction of a strawboard and paperboard mill to include boiler plant at Winnipeg, Man. Estimated cost \$1,000,000. Private plans. Equipment consisting of beaters, cookers, jordan, paper machine, calenders, etc. will be required.

Sulphuric Acid Plant—Stauffer Chemical Co., H. A. Wurzbacher Dist. Mgr., 3730 South St. Louis Ave., Chicago, Ill., will soon award contract for the construction of a sulphuric acid plant at Hammond, Ind. Estimated cost \$1,000,000. C. A. Mohr, c/o owner, is engineer in charge.

Tile Factory—U. S. Encaustic Tile Co., 359 West 16th St., Indianapolis, Ind., awarded contract for a 60 x 90 ft. factory to P. A. Nee Co., 526 Lemcke Bldg., Indianapolis. Estimated cost \$40,000.

Tunnel Kiln Addition—Mayer China Co., Beaver Falls, Pa., awarded contract for a 1 story, 40 x 200 ft. addition to tunnel kiln on 6th St. to Harrop Ceramic Service Co., 310 West Broad St., Columbus, O. Estimated cost \$50,000.

Varnish Factory—Holland Varnish Co. Ltd., 4700 Park Ave., Montreal, Que., is having plans prepared for the construction of a varnish factory on Atlantic Ave. Estimated cost \$200,000. T. Pringle & Sons Ltd., Coristine Bldg., Montreal, are architects.